THE

ANATOMIST'S INSTRUCTOR,

AND

MUSEUM COMPANION:

BEING

PRACTICAL DIRECTIONS FOR THE FORMATION AND SUBSEQUENT MANAGEMENT OF ANATOMICAL MUSEUMS.

BY

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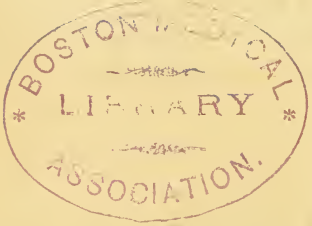

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TO

FREDERICK TIEDEMANN,

PROFESSOR OF ANATOMY IN THE UNIVERSITY OF HIEDELBERG,

&c. &c.

In testimony of respect for his private virtues, of esteem for his public character, and as an expression of admiration for the magnificent yet useful works bestowed by him on his professional brethren,

THE FOLLOWING TREATISE

Is most respectfully dedicated by

FREDERICK JOHN KNOX.

PREFACE.

If Museums, whether of healthy or morbid anatomy, are of any use in the acquisition of anatomical knowledge, it has for many years appeared to me that a practical Treatise on their formation and subsequent management, would be a great boon to the student. Few of the museums now existing in Britain have any thing like a descriptive catalogue attached to them; and even where such does exist, it forms more a subject for occasional reference than frequent examination. I many years ago suggested the propriety of printing such catalogues in fasciculi, and the benefits which would have resulted, I am still quite satisfied would have been very great.

Perhaps few persons have enjoyed more extensive opportunities than I have done, of acquiring a practical knowledge of the almost endless variety of anatomical arts. Whilst assistant to my brother, then Conservator of the Museum of the Royal College of Surgeons, I dissected and displayed, for a succession of years, from two to three hundred preparations annually. In addition to sundry minor collections which the Royal College purchased, the Windmill Street Anatomical Museum (consisting of between 3000 and 4000 preparations) also became the property of the Royal College; and in consequence of

the difficulties attending the transport of such delicate materials, and the unhappy want of accommodation then experienced by the College, my duties were most arduous. Within the short period I think of three years, this collection was removed from London to Edinburgh, and whilst in Edinburgh, was removed from place to place, and displayed twice over. The actual labour which this gave rise to, can be appreciated, I am convinced, by only a very few individuals. Many of the preparations composing the Windmill Street collection had been put up by the first masters of the art; and in repairing the damage done by the repeated removals, I had an opportunity of seeing all the various plans resorted to by Wilson, Cruickshanks, and others, for displaying healthy or morbid structure.

In drawing up the following treatise, my leading object has been to make the student *really* fond of visiting museums; and, with this view, I have done every thing in my power to make him practically acquainted with the mechanism of anatomical and pathological museums. So long as mere amusement forms the inducement for visiting a museum, not the slightest benefit can accrue from such visits;—there can indeed be nothing in an anatomical museum calculated to amuse any one. Instruction, and that of the very highest order, is to be sought for, and will in general be found if sought for aright. It appears to me quite an axiom, that what we do *not* understand we take little or no interest in; and I trust it will be admitted, that few on entering the profession understand any thing

about museums. The Hunterian Museum in London proves that the individual who formed it preceded his contemporaries by nearly a century, in every thing connected with the scientific part of our profession. It is admitted that a great many preparations in that museum point out facts with which we are still unacquainted. So few indeed appear to me to be aware of the true nature of museums, and *what* they are to see and learn by visiting them, that I for a long time doubted very much the use of *extensive* collections. Experience, however, has convinced me that museums cannot be too numerous or extensive. Without museums the profession would be in the state of man without a language.

Most professions admit of being divided into what is merely mechanical and what is strictly speaking scientific; but it will be found, I rather think, that this distinction can scarcely be made in anatomy. The surgeon, in order to rise to eminence, requires to be equally well acquainted with the saw as with the growth and regeneration of bone; and unless the conservator of a museum can himself perform every little manipulation, in addition to that which is purely scientific, the work of the museum will never thrive in his hands. I by no means wish it to be understood that assistance cannot be procured; only I am quite sure that the best directors in any undertaking (and all surgical operations come strictly under this denomination) will be those who are themselves thoroughly acquainted with all the minutiæ. It is also very satisfactory to think that all manipulations in the museum department are strictly professional. The indi-

vidual who can display to advantage a pathological preparation, will find little or no difficulty in performing all the minor operations of surgery; on the other hand, let the scientific acquirements of a person be ever so great, without a practical acquaintance with the use of the forceps, he will never succeed in extracting a stone from the bladder: now the whole steps in lithotrity, or that of breaking down the calculus in the bladder and removing it piece-meal, are purely mechanical; perhaps the less scientific the operator is the better.

In the Second Part of the work, I have given, under separate heads, lists of the pathological appearances of the various textures *admitting of being preserved.* I anticipate that these lists will enable the student, on entering a museum, to direct his attention more particularly to any class of pathological preparations, and thus form, as it were, a groundwork for new and future investigations. My observations will, I trust, also enable the student at once to perceive whether the preparations have really had labour bestowed on them, or are merely preserved from decomposition; and will at all times put him on his guard with respect to the inevitable changes on the colour and delicate textures caused by the modes adopted for preservation.

CONTENTS.

PART III.

CHAPTER I.

THE

ANATOMIST

AND

MUSEUM COMPANION.

INTRODUCTION.

When engaged in communicating instruction in Practical Anatomy, I have been repeatedly applied to by the student for information not directly connected with the pursuits in which he was then engaged, and consequently misplaced. I at the same time could not but observe, that part of the information required would greatly have facilitated the student's labours; and regretted that the lengthened details necessarily involved in the questions put, rendered it altogether hopeless to give him such verbal instructions as might be useful to him. It has repeatedly suggested itself to me, that practical instruction on the mode of investigating and preserving healthy and morbid textures might be given, with quite as much advantage to the anatomical student as Practical Chemistry; but this would have been expensive, as adding another L. 3, 5s. to the student's already very heavy outlay, and I disliked even the chance of prematurely withdrawing his attention from the practical rooms as now conducted, and which must always precede his engaging in the investigation of morbid structure and the anatomy of tex-

tures, which indeed constitute the scientific and more refined departments of his profession.

A careful perusal of this publication will, I sincerely trust, enable the student to benefit much more than hitherto from attending lectures, whether of Anatomy or Physiology, and more especially Pathology. In visiting museums, I am perfectly satisfied (notwithstanding all that is said to the contrary), that the student has hitherto derived little or no advantage; to him they are, in fact, "sealed books." Lectures on Anatomy are, or should be, perfectly finished demonstrations, combining as many illustrations or proofs as is possible, of the facts more immediately under the lecturer's consideration. There can be, I presume, but one opinion of the importance of museums to a teacher. It is a fact that Dr Barclay (the most successful teacher that ever lived) demonstrated the arterial and venous system solely from *dry preparations*. Many objections have been urged against this practice; and although I admit that it is highly objectionable, yet it seems to me the best which can be adopted, considering the extremely limited period to which the course of anatomy is confined, and more particularly during the existing regulations regarding dissection. A perusal of the following pages will also explain to the student the true nature of vascular preparations; and, being put on his guard as to the faults and imperfections under which they labour, the beginner even may study them with comparative safety.

Anatomy cannot be taught without a museum, and the more extensive the better, provided the lecturer himself is perfectly acquainted with the museum from which he purposes to draw his illustrations. The student, however, should also know something at least, of the various manipulations resorted to in preparing the materials for such lectures. I feel assured that, if the student enters fully into the spirit of the following pages, a vast number of the minor details which the lecturer finds it necessary

to enter into might be omitted in lectures, and thus enable him to devote a great deal more time for the difficult and complex anatomy of the nervous and vascular systems. It is a fact universally admitted and acted upon by all lecturers, that they cannot avail themselves even of the small collections which many possess, owing to the destruction consequent on exhibiting the preparations, arising solely, as I think, from the total ignorance on the part of the student of the nature of these preparations. A lecturer not a hundred miles from Edinburgh, although an enthusiast in museums, and possessed of a very valuable one, will not allow any student to handle, or even touch, a single preparation: his reasons are the same as those of other lecturers, viz. the consequent destruction of his museum. One would imagine that some kinds of preparations might be with safety entrusted to the student's inspection; but this gentleman thinks not, and states, that, when he was a student, he used to perforate the top (see sect. 9) of preparation jars with pins. This procedure would certainly rapidly destroy a museum, and give rise to an expense on the part of the teacher that nothing but a wealthy endowed chair could stand. So far as my own observations go, I am quite certain that few preparations can be entrusted into the hands of students; and I feel extremely anxious, if possible, to correct this most unfortunate want of knowledge. By referring, for instance, to chapter V, the reader will perceive that the articulated skeleton will not bear the same violence which may be applied with impunity to the living body; and a knowledge of this, instead of it apparently giving pleasure to many to twist off a toe or a finger, will give them real pain from perceiving that they have seriously and permanently injured an anatomical preparation. Again, a perusal of sects. 7, 8, &c., will at once convince them that preparations in glass-jars must not be inverted (a proceeding actually recommended to me, whilst Assistant-Keeper of the Museum of the Col-

lege of Surgeons, by an ancient surgeon, as a means of preventing the evaporation and consequent great loss of the whisky), and that a pin thrust through the top is a mode of injuring the private property of their instructor, indicating a feeling on the part of the student which must render all attempts on the part of the teacher to instruct him entirely abortive. A collection of sufficient extent to enable the teacher to give a complete course of anatomy in the short space of five or six months, cannot be supported under an annual expense of L. 250 Sterling, exclusive altogether of the cost in purchasing objects, and in originally fitting up premises. The trouble of keeping the museum of a teacher in order, very far exceeds that of a public collection, however extensive. Preparations are often even carried away out of mere wantonness, causing a feeling of distress to the proprietor which it would be impossible to describe. The value of a preparation may be greatly heightened by some peculiarities in the case; and a series of lectures may possibly hinge, as it were, upon this single record, whilst in the mean time the preparation is itself of little value, and certainly of none to the person so removing it. In most public museums the preparations, besides being secured in glass-phials, &c., are enclosed in glazed cases, and I admit not easily seen by the student so as to be useful to him. The projecting shelves, so extensively adopted in the arrangement of the Museum of the Royal College of Surgeons, were first resorted to by me in consequence of the want of room; their premises being at that time much more limited than at present. The preparations are well displayed, but, in consequence of the exposure to handling, and the constant change of temperature which must be going on in a room heated during the day, and left for three days in the week, and every evening, to sink down to an extreme degree of coldness, must be continued at great loss by evaporation. The preparations inclosed in glazed cases are by no means exposed to the

same vicissitudes of temperature, and are consequently much better preserved. Under these circumstances, and the printed Catalogues being, without exception, a mere list of barren names, it is only whilst attending the lectures of those teachers possessed of private museums that the student ever has an opportunity of understanding the greater number of anatomical preparations.

Anatomical Museums contain the various parts of animal bodies preserved in such a manner as to exhibit either general formation, or healthy and morbid structures, &c.; and seeing that the elementary textures of animal bodies are in reality so few, it is truly astonishing, and at first thought surpasses belief, that collections of such vast extent as even Britain now possesses can possibly be required for the purposes of science. In giving instruction in every art or profession, certain means must be resorted to by the teacher; and he who attempts to teach anatomy without a museum *bona fide* his own, and, if possible, made by himself, as strictly deserves the name of impostor, as the mechanic who would undertake to enable any one to make an article of furniture, by reading over to him some of the ordinary principles of mechanics, without *even* exhibiting the saw, chisel, hammer, &c. I have observed that each individual exhibits certain peculiarities proper to themselves, and that every museum takes its character, as it were, from the person who may have formed that collection. It is sufficiently striking that most anatomical collections now existing have been founded and completed by single private individuals. It would appear that the love of discovery is the only incentive to induce a person fit for the task to continue his labours, so as ultimately to form a museum of any extent. If the collection is to be of any use, the person must be capable of not only using his mental faculties, but possess manual mechanical dexterity; and when both these are called into play, few constitutions can stand the nature of the work more than a

few months; so that a very high salary to a conservator will seldom produce an extensive museum. If money is the sole incentive, the collection will not increase, or, if it does, mere trash will in general be preserved. Whole days may be spent on a single preparation, which could have been put into a jar containing alcohol without a minute's time having been given to it; and if the principal proprietor, or public body, should be incapable of appreciating the extent of labour bestowed, then it is clear that it has been bestowed in vain, or, at all events, with a most baneful and withering effect on the person who bestowed the time and trouble. The preparation might have been *preserved*, as we have remarked, in a few minutes, and the conservator enjoying himself in the fields, instead of laying the sure foundation for ill health by his labours. Whilst in charge of the museum of the Royal College of Surgeons, the preparation No. 907, Table No. 1 (a hydrocephalic head), was brought to me, with much of the soft parts present, but in a state which I knew well would not have yielded to maceration before the bones themselves were also destroyed. It was too valuable to risk boiling, and it was evident, indeed, that the softness of the bones would not have admitted of this. I accordingly deliberately cleaned this head with infinite labour.

Every one having the slightest desire for anatomical knowledge, and who hopes to derive the least advantage from visiting museums, should have dissected and prepared most textures with his own hands. It is well known that the museum now belonging to the Royal College of Surgeons of London was the work of John Hunter. He injected, dissected, and *finally prepared* most things with his own hands. I remember, whilst assistant keeper of the Museum of the Royal College of Surgeons in Edinburgh, of being visited by a Dr Y——g, who, in consequence of my having repeatedly had occasion to point out to him the care necessary to

preserve the museum from visitors (not merely students, but professional men) not knowing what will admit of being touched and what will not, related the following anecdote to me. Whilst visiting Dr John Hunter's museum with some friends, Dr Hunter as usual accompanying them, they reached a corner of the room where a corroded kidney had been deposited to dry. The preparation lay broken into two or three pieces, and the attention of the party was roused by Dr Hunter exclaiming, Who has done this? A painful silence ensued, when, a young man standing near being apparently on the point of confessing, Dr Hunter said, "But do not tell me, for I shall curse him to the hour of my death." This was a dreadful expression, but I can readily understand how any one, after having spent perhaps days, or it may be months, in preserving a preparation which can never be replaced, may be driven to a state of actual frenzy by the idle curiosity of some uneducated person.

Dr Hunter would allow nothing to be thrown away, so that, at his death, the quantity of things in store, *i. e.* not finally displayed, was immense, nearly equalling his manuscripts, and, as it appears to me, are likely to build the future temporary reputation of some dozen pretenders. It is, however, a foundation of sand; but the foundation would be surer were those persons at once to inform the public of the sources from which they draw their wonderful discoveries. I am perfectly aware that original research into animal structures is painful, and destructive to health; but I presume that, unless the route followed be that of Hunter, Tiedemann, or Meckel, posterity will be sparing of praise, however lavish the world may be of their riches and honours during the life of the individual.

EXPLANATION OF THE PLATE.

Fig. 1. Skeleton of the Bantom, prepared as a *Natural Skeleton*, and finally set up to dry. A, portion of a frame supporting the head during the drying process; and particularly described in the section treating of the mode of preparing the natural skeletons of birds.

Fig. 2. Drill-stock, of almost universal application in the hands of the Practical Anatomist; the addition of the screw a most important one.

Fig. 3. Best form of glass-jar for enclosing wet preparations.

Fig. 4. Form of glass-jar in ordinary use.

PART I.

ON THE MODE OF FORMING ANATOMICAL MUSEUMS.

CHAPTER I.

1. Various methods followed for preserving the soft textures.—2. Preservation of textures by simple drying.—3, 4. Caution against the use of varnish.—5. The real use of *vascular* preparations.—6, 7. Preservation by means of alcohol, and care necessary in preparing parts to be thus preserved.—8. Period for finally putting up a preparation not optional.—9. Difficulty in preventing the evaporation of alcohol, and modes generally resorted to.—10. The application of Caoutchouc for this purpose.—11. Turpentine used in destroying insects, and displaying certain preparations. The evaporation of the spirit effectually prevented.—12, 13. Best form of the glass-jar.

1. All parts of animal bodies, when life has ceased, have a constant tendency to decay and return to dust; and although nothing can prevent this entirely, yet its progress may be arrested for a certain number of years. Some textures are evidently more prone to decay than others, and even certain conditions of the animal during life seem more favourable for hastening decomposition than others. The presence of oil or fatty substances forms the principal difficulty encountered by the anatomist in preserving either morbid or healthy structure. If the texture admits of being dried, such as the bones (although even these will decay rapidly if they contain oil), then all that is necessary, when fully cleaned and

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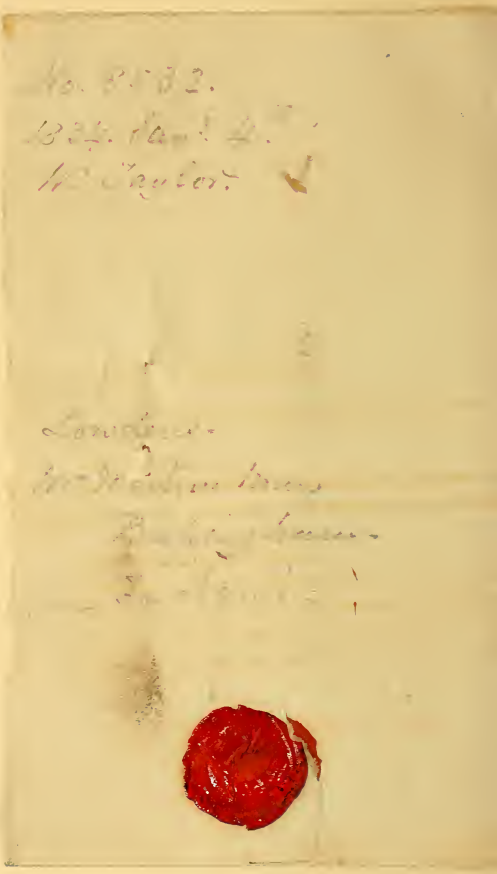

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dried, is to preserve them from dust and damp. Most of the textures admit of being dried, but this may entirely defeat the object of the anatomist, and thus the use of certain fluids possessing an antiseptic power has been resorted to.

2. The variety of soft textures which may be preserved by simply drying them is very great; and the dried preparation which has been assiduously attended to *whilst drying* has always appeared to me to give a clearness and an extent of information which is seldom equalled by the wet preparation, or that preserved in spirits of wine. Those preparations intended for drying will either require to be stretched out by means of pins, on a board composed of soft wood, and perfectly smooth; or, in the event of being hollow, such as the stomach, bladder, &c. they must be distended with air, if entire, or, if not admitting of being distended with air, may be stuffed with baked hair or wool. Oiled paper, such as is used for tracing, may be used, so as to prevent the preparation adhering to the board or the material made use of in stuffing. All preparations of this kind should be as fresh as possible, and yet they should be completely cleared of blood, &c., by means of maceration in water. Should any fat be in the texture, it will of course render the preparation always oily; so that, if a choice can be had, those which are free from fat should be preferred. We cannot of course at all times command the summer heat, and must sometimes have recourse to artificial heat to dry the preparations, for the quicker the drying process proceeds the better. I have found it often impossible, in consequence of continued moist weather, to dry a preparation in winter, and have thus been compelled as it were to invent some means of enabling me to wait for more congenial weather. This I found I was enabled to do with a striking improvement to the preparation (sect. 3).

3. The part, being quite ready for drying, should be

put into a dish, covered with proof spirits, and evaporation prevented by means of a close cover; or, if bulky, merely wrapped in a cloth moistened from time to time in alcohol. It may afterwards be finished off at any period, and it dries and looks the better by having been immersed in spirits. These preparations, when dry, if membraniform, may, if the anatomist thinks proper, be varnished with fine copal varnish; but I have entirely given up the *use* of varnish for many years. If the preparation is bulky, such as an extremity, to shew the distribution of the arteries, then I particularly urge the anatomist never on any account to use varnish.

4. My objections to the use of varnish, I am aware, will require to be clearly and forcibly stated, as its use is at present almost universal. Whilst in charge of the Museum of the College of Surgeons, an extensive collection of vascular preparations was presented to the college by Dr John Thomson. They had all evidently received abundance of varnish; and in consequence of the succession of coats of varnish and dust obscuring the arteries and veins, an attempt had been made to paint these. I observed, in the mean time, that these preparations had not been in the museum for many hours, when, on lifting any one of them, there invariably remained various little hillocks of a fine brownish-looking dust. I knew this to be the effect of a very active small black beetle, common in museums, and instantly gave these preparations a thorough examination. I found these beetles in thousands; they had undermined every texture, the thick coating of varnish in many parts only remaining. It is true that repeated applications of turpentine destroys all insects; but the varnish so effectually prevented the turpentine from reaching the central parts, that I despaired of completely clearing the preparations. I kept them in an apartment separate from the museum, and gave them a daily visit for many months. My mode of preserving the largest vascular preparations,

however great the quantity of muscle may be, is simply to dry it, having previously cleared it as effectually as possible of blood, and soaked it well with spirits of wine. During the winter months a little mould will often make its appearance, even in the best arranged museums; but this can be instantly removed by means of turpentine applied with a brush. In summer, air should be freely admitted to the cases containing the preparations, and turpentine freely applied. If oil should appear on any part, it may be removed by means of a little tow. I have now in my possession vascular preparations preserved in this manner ten years ago, and which look quite as well as when prepared, and, I may add, as well as any I have had an opportunity of examining. The Barclayan Museum was very rich in vascular preparations, and, having had it under my care for a length of time, I observed that all these preparations had been varnished. The insects were abundant, but not so numerous as in the collection to which I have already alluded. The greater proportion of those in the Barclayan museum were intended to shew the number of minute branches into which arteries divide, having all the muscles, nerves, &c., cut away, so that little was left for insects to pick at. Another set of vascular preparations, of very superior utility to the minutely dissected ones, had suffered prodigiously from insects, the material used in filling the vessels having mostly been composed of tallow.

5. The sole object, in my opinion, which the anatomist should keep in view in preserving portions of the human body as vascular dried preparations, ought to be the Surgical Anatomy, or that of Relation. These preparations, however, can never supersede the use of the *subject* in the lecture-room; and to the surgeon properly educated, a good plate is a thousand times more handy, and quite as useful, as an ill-prepared mummy.

6. The greater proportion of morbid appearances, and

many of the healthy structures of the body, require to be preserved, as wet preparations; nearly every minute structure, can only be preserved by this means. A vast number of objects in Natural History even, are also best preserved in alcohol; and thus museums are mostly composed of glass-jars, arranged on shelves, having objects inside floating in a fluid. sometimes clear and transparent, sometimes the very reverse.

7. The whole process of preserving anatomical objects in a soft state, requires a care which few persons have the slightest idea of. I remember a gentleman, who had very considerable pretensions to be ranked as a pathologist, presented to the museum a preparation of fracture in the neck of the femur. The opinions of surgeons regarding the pathology of this accident were then, as now, very various; and the number of opportunities of observing the condition of the injured parts in a recent state being comparatively few, great care was bestowed in dissecting the specimen. By-and-by the gentleman required the preparation for his lectures, and it was, according to a regulation of the Royal College, given to him. Upon being returned to me, I found it covered with dust, hairs, &c.; and, on inquiry, found that it had been removed from the jar, handed about the class on a dirty trencher, wiped by the common doorkeeper, with the cloth with which the seats of the classroom had been *carefully* cleaned for the preceding week! I refused to receive the preparation into the collection. The dissection of the part generally requires a minute knowledge of anatomy; it must be conducted in such a manner, that not the slightest particle of dust may come in contact with the part dissected; if containing blood, it must be put amongst water, and changed hourly, until the blood is got rid of. It will occur to the student that the extraction of the blood, and consequently the colour, is a serious objection. We admit that it is so, but there is no remedy for it; for the alcohol would extract the co-

lour, if not previously done by means of water, and the preparation, if put up full of blood, would in a few days be perfectly invisible, in consequence of the discoloration of the spirits. We can thus, in most cases, only shew the *results* of inflammation; so that, in the early stages of inflammation, where little or no change has taken place on the texture, except perhaps an increased degree of vascularity, it will be of no use to attempt the preservation of the part in alcohol. I have, however, succeeded perfectly in preserving this increased vascularity of a membranous part, by simply drying, without using any macerating process. The drying process must be conducted rapidly, and, if in winter, of course by means of artificial heat. The blood in the vessels comes by this means to answer the purpose of a very fine injection, being rapidly dried in the vessels, and appearing opaque, whilst the tunics, of intestines for instance, dry as a delicate semitransparent membrane.

8. It is a common belief amongst anatomists, that the dissection and preparation of any part, healthy or morbid, may be completed *at any time;* but this is quite a mistake, the whole process must be begun and finished off hand. A number of preparations collected in Paris, and rudely put in jars for final adjustment in Edinburgh, now in the Museum of the Royal College, are nearly without exception mere *records* of very lengthened cases, not the slightest trace of the morbid alteration spoken of being discoverable in the preparation, so that they *may* or may *not* be the parts spoken of! I recollect receiving an interesting preparation, but the *case* not being forthcoming at the moment, a gentleman, who never had seen nor heard of the patient, very gravely offered to draw me up a case of any length I wished! My object in wishing for the history of the specimen, was for the purpose of enabling me to do all justice to the preparation by dissecting and preparing it in such a manner as to give some practical and useful illustration. The part must be dis-

played by means of bristles, bougies, slips of fine glass, &c. and suspended so as to be seen to the best advantage; and, lastly, the glass-jar requires to be enclosed in such a manner as if possible to prevent the evaporation of the preserving liquor. Thus the number of minutiæ to be attended to are not only multifarious, but most of them require patience, and a mechanical turn, added to as much anatomical knowledge as possible,—the more the better. I have seen many fine preparations destroyed by persons perfectly capable as anatomists for dissecting them, who were yet unable to attach a thread or hair to suspend them in the jar. I use for this purpose a silver probe, having a flattened extremity, in which there is a round opening, sufficient merely to allow of the passage of a fine needle and thread. The flattened extremity of the probe being placed under the preparation at the part by which I wish to suspend it, the needle is to be passed through it and the rounded eye of the probe, the thread will follow the needle, whilst the rounded opening in the silver probe will not allow the most delicate membrane to follow. In dissecting delicate preparations for preservation in spirits of wine, such as the eye, the anatomy of the fœtus, and indeed all membraniform textures, it will be necessary to have them fixed, and under water; this is effected by having a few pudding dishes, the bottoms of which you have previously covered with wax, in the manner as directed for making wax tablets,* only not oiling the bottom of the dish,

* Wax-tablets, made by melting common but good bees-wax over a slow fire, and carefully mixing any colour, such as vermillion, king's-yellow, imperial blue, &c., and whilst in a fluid state pouring it out on a flat dish, previously slightly oiled. Upon cooling, it may be removed from the dish, and cut into tablets, so as to suit the jar fitted for the display of the preparation; delicate membraniform parts can be stuck on these tablets by means of bristles or common pins, and a deal of their anatomy displayed. These wax-tablets ought to be at least 3–16ths of an inch in thickness, and instead of mixing a colour the wax may be simply dyed.

when the wax will be found to adhere to the bottom. The advantages of this mode of proceeding is, that, after you have dissected and prepared the preparation under water, you can pour off the water and substitute alcohol, without moving the preparation, and thus harden it, and indeed fashion it to any form desired; and this form it will be found to keep when finally put up. If the parts are extremely delicate, the jar and tablet having been selected and prepared, the wax tablet may be used at once for the dissection, and the whole process thus conducted off hand, and no farther change made, except the transfer of the tablet and preparation from the flat dissecting dish to the glass-jar.

9. The complete prevention of evaporation of the alcohol or antiseptic solution has never been discovered, though most anxiously sought for. The idea that alcohol evaporated faster than other fluids, and that it was expensive, seems to me to have given rise to a variety of attempts to substitute something else of a cheaper nature,—such as weak solutions of sulphuric acid, salt and water, &c.; but the alcohol is the least expensive part of the process, and I am much mistaken if the *extensive!* collections which I was informed were getting up all over England where salt and water was used, are now in existence. The material I have always preferred, therefore, is alcohol, distilled from grain, and rectified. If the preparation has been sufficiently macerated in water, which should be continued until all the blood is extracted, proof spirits will answer almost every purpose. It has been supposed by most persons that the evaporation goes on even through glass, but I doubt this very much. It is true that many of the preparations in the Bell Collection, when it was placed under my charge, were enclosed in jars provided with ground glass stoppers, and in these the evaporation had evidently gone on to a great extent; but this I attribute to the imperfect adaptation of the glass-stopper, which may be so stiff as

not easily to be removed, and yet not perfectly close all round. Amongst a collection of pathological preparations presented to the Royal College by Professor Russell, there were a number of jars provided with thick crown-glass covers, ground to the rim of the jar, and kept on merely by means of a covering of bladder. The evaporation seemed to me to be entirely prevented in these preparations; and the only reason which I can see to prevent the universal adoption of this mode, is the difficulty of suspending and displaying the preparation, and although this is overcome, the great expense and trouble of procuring jars of proper shape and size, furnished with their crown-glass covers. A great variety of preparations require three or four parts to be suspended, and attached by some means around the circumference of the rim. These preparations are generally of such a size as to require a jar, the diameter of whose rim shall range from three to five or six inches; and the only alternative is to bring the suspending threads over the rim, and secure them by passing another thread round the neck. We have thus, it must be admitted, established a sort of capillary attraction,—a most effectual mode of emptying the jar of spirits. The ends of the suspending threads are, however, brought back into the interior of the rim, and the jar being filled quite full of spirits, a bullock's bladder, macerated until perfectly soft, is stretched over it, and secured by passing abundance of fine twine round the neck of the jar. Tin-foil, neatly cut so as to come slightly over the rim, is then to be applied, and another coating of the bladder stretched over as before. This last layer of bladder should be secured by a great quantity of coarser twine, so as to bind it firmly to the neck of the jar, and cause it to descend considerably lower down than either the first coating or tin-foil. When thoroughly dry, the outer string may be removed, and the top painted any colour, composed mostly of varnish, to suit the taste of the anatomist. This, with slight modifica-

tio is ns, the ordinary mode of enclosing wet preparations, and it prevents evaporation for a very considerable length of time, but still it goes on surely, though slowly, and collectors increase the number of layers of bladder and tin-foil, or substitute sheet-lead, but all to no purpose. In examining these, (and I regret to say many a precious summer of my time have been spent in this way), I generally found the tin-foil or sheet-lead completely oxidized, and converted almost into powder. The position in which the metal is placed, I perceived was peculiarly favourable for producing this change, and I resolved to change the position of the metal, and put it first on, using pure tin or zinc plates instead of lead, the succession of bladders following. Here the suspending threads passing over the rim of the jar became a serious objection, inasmuch as the metal evidently could not get closely applied to the rim, and I found the tin-foil preferable, unless I avoided passing any thing over the rim. This can easily be done if the diameter of the jar does not exceed three inches, by fitting a pretty strong portion of an old whisky barrel to the interior of the rim, in the form of a transverse beam, so as to be below the precise margin, and yet have such a hold as not to be easily forced down. The suspended threads are attached to this beam. The evaporation by this mode goes on much more slowly, and the metal does not, so far as my experience goes, get oxidized. Were it possible to keep these preparations, thus put up, always in the same temperature in which they were when finally prepared, it is almost certain that they would stand unchanged for many years, but the anatomist will, on a moment's reflection, perceive that the very change of season renders this impossible. Condensation and expansion will, at every change of temperature, go on, and if the top is of a composition not readily to yield under these changes, the connection between the bladder and rim around the margin will be forced to give way. If composed of blad-

der, this opening will soon become permanent, as the bladder, when dry, will not again adhere, if once shifted. The placing the bladder next the spirits has this great objection, that the whole surface must be continually moist, and we know that a very curious mode of transudation takes place between fluids and wet or moist bladders. The metal, therefore, should form the first layer, and, in all preparations of a small size, the cross piece of stick as a means of suspension adopted, instead of bringing the threads over the rim. Glass floats, pieces of cork, and various other modes of suspension, have been resorted to; but as the proper display of some particular part (and that generally minute) is the sole object of the preparation, that must be provided for in the first place, and without something perfectly fixed, it is impossible to suspend the part as it should be. I have often observed a deal of pains had been bestowed in suspending preparations, which would have been far better displayed by merely having a bristle or two passed in such a way as to fix the part in the jar by resting on the bottom of the vessel.

10. Caoutchouc, in thin plates, can be readily had in many stationers' shops, and this forms a most admirable means of enclosing wet preparations. It appears to me to possess all the requisites required for preventing evaporation; and, at the same time, admitting of the necessary suspending means by threads or horse hair being had recourse to. The mode I have adopted of applying the caoutchouc is as follows: I take a square portion the size of the diameter of the rim, and apply it for a few seconds to the top of a tin-kettle in which water is at the moment boiling, or it may be placed in the water for a short time. The caoutchouc becomes extremely soft, and so pliable as to admit of being considerably stretched. I apply it to the rim of the jar so stretched as to include the whole of the rim and neck, and instantly follows its application with a turn or two of fine twine. The caout-

chouc gets firmer when it cools, and retains the form of the rim of the jar, so that it can be taken off and again applied without repeating the softening by means of heat. If the preparation is to stand in a private cabinet, I am of opinion that nothing more is required; but if in a Museum, where it will be often handled, and exposed to much vicissitude of temperature, a single layer of finely prepared and very soft bullock's bladder had better be passed over it. I use no paint or varnish of any kind. Caoutchouc is soluble in naphtha, turpentine and ether, and a solution thus obtained might be first applied to the rim of the jar, and then the caoutchouc cover stretched over the whole top and rim, as already described; the naphtha evaporates, and leaves the caoutchouc nearly in its pristine state; this must constitute an exceedingly nice adaptation of surfaces, but its application will be found difficult, in consequence of the jar being, of course, full of spirits, and it must never be forgotten that the display of the morbid part is, after all, the most important consideration.

11. Turpentine forms an essential in the work-shop of the anatomist. I have found it a complete specific against insects. Its use is cleanly and safe; and it is of extensive application in the preservation and display of certain kinds of preparations. All preparations which are to be preserved in turpentine must be first *dried*; and in our enumeration of the various more striking preparations, we shall particularly note those which are to be preserved in turpentine. We shall here confine our observation to the mode of securing the turpentine in the jar. In the Barclayan and Bell Collections, when put under my charge, a very considerable number of preparations were preserved in turpentine; but, particularly with regard to the former, the attempt was an entire failure, in consequence of the turpentine constantly trickling down the outside of the jar, and, when partially dry and mixed with dust, becoming a kind of paint, rendering the pre-

paration in general invisible, and the jar itself perfectly intangible. Those thus prepared in the Bell Collection were not just so bad; and this, I observed, was owing to the superior form of the neck of the jar, and the extreme care which had been taken in inclosing the preparation. The preparations, we have remarked, are to be first dried; and therefore most of them will be found not to require *suspension*, provided the jar is properly suited in size to the preparation. Should a means of suspension be required, a portion of wood must be used, as the threads must on no account pass over the rim of the jar. These preparations should always be put up during summer, or in a room properly heated, and the jar filled quite to the brim. A single layer of *very soft* (*but not putrid*) bullock's bladder is then to be stretched over the top, and neatly secured with two or three circles of fine twine, particular care being taken that no air is allowed to remain between the bladder and the neck of the jar. The bladder should then be trimmed away, but not too closely, and must be so soft as to adhere perfectly to the jar.* Nothing more is required; the bladder very soon dries, imbibing a quantity of the turpentine, so as to become semi-transparent; and, if proper attention has been paid to the softness, and at the same time *goodness*, of the bladder, such as being quite sound and free from fat, there will be no trickling down the sides of the jar; and, indeed, so far as I can observe (from some preparations in my possession, and many in the Museum of the Royal College of Surgeons, and which have been standing there thus prepared by myself, for six or eight years), no change whatever on the turpentine.

12. Fig. 3 (see Plate), gives a view of that form of glass-jar in which I have observed the evaporation of the alcohol, however covered in, to proceed most slowly. I attribute this to the contracted form of the neck. This

* The very singular fact of one layer of bladder preventing the evaporation of turpentine was discovered by me by pure accident.

jar should be at least an inch or more longer than the preparation requires, as the bulging shoulder of the jar has an effect in obscuring the object inside. It necessitates, also, a greater diameter in the body of the jar than is required by the preparation, but this in most cases adds amazingly to the beauty of the specimen when finished, and is therefore no detriment.

13. Fig. 4. (see Plate) gives a view of the ordinary form of glass-jar used; and where we wish to avoid a bulky jar it is the best form. The caoutchouc cover will prevent the evaporation of the spirits, although, with the common cover, the evaporation in this form of jar goes on *very* fast. Another modification, in the form of the rim of the jar, is, instead of a projecting lip, to have a solid ring, the interior rising smooth and quite flush up to the margin, whilst a groove runs all round the margin. An oval-shaped jar looks well, and, when the preparation has a flattened form, saves a prodigious quantity of spirits. Indeed I may say there is no doing without the oval-shaped jars, but I caution the anatomist that they are not easily procured, and are very apt to break. The only way of procuring a handsome shape is to get hold of one and send it as a pattern to the glass-blower; and, finally, if possible, superintend the blowing in the glass-house.

CHAPTER II.

14. Injecting the arteries, veins, lymphatics, and lacteal vessels—15. Instruments required.—16, 17, 18. Remarks on the kind of injection to be used.—19, 20. Size or minute injections.—21, 22. Varnish or fine injection.—23. Wax or coarse injection.—24. Paint or cold injections.—25. Mercurial injections.—26, 27. Instruments required for mercurial injections.—28. Corroded preparations.—29. Vascular preparation of the thoracic extremity.—30. Display of minute distribution of vessels.—31. Preparations of veins—32. Lymphatics—33. Lacteals.—34, 35, 36. Preparations of the nerves.

14. The structure, and particularly the course and connection, of the arteries, veins, and lymphatics, but more especially the arteries, have at all times formed an interesting field for investigation, and at the present day are considered so important that we can scarcely imagine what the ancients knew of anatomy, since before Harvey's time the whole subject of the circulation was a complete chaos. Without the discovery of the now apparently simple procedure of injecting or filling these various systems of vessels with a certain fluid, our knowledge of anatomy must have remained extremely limited, and of little practical utility. The circulation was shewn by Harvey, and discovered by him by means of the art of injecting. And the mechanical yet scientific (rare combination!) Hunters generalized the labours of Harvey and his followers, and shewed the practical utility of the discovery. Hunter, it is believed, injected and dissected almost every thing which he had leisure and opportunity to describe, with his own hands; and, with an example of this kind before us, we proceed to give the result of our labours in this department with peculiar pleasure. We are only

sorry that we have nothing very new to bring forward, and our object will be rather to state what is really worth knowing, so as to lead others to direct their attention to improved methods. We shall presume that our readers are to a certain extent familiar with the structure of the bodies of animals, and therefore avoid a deal of circumlocution and verbiage.

15. The instrument used for throwing the fluid materials into the vessels is a brass syringe, sold by almost every cutler. These syringes are of various sizes. If the injection used is heated, and the subject bulky, admitting of being only partially heated, the syringe will require to hold as much as will at once fill the vessels; otherwise, in consequence of the *setting* of some parts of the materials in the vessels during the time required for refilling the syringe, an obstruction will be offered to the further passage of more fluid into them; and any attempt to force this, is almost invariably attended with the bursting of some of the vessels and the failure of the attempt, besides in all probability the destruction of the preparation. These syringes are handsomely fitted up with every requisite, and the anatomist who can ever hope to inject, will easily make himself master of their mechanism by unscrewing them once or twice with the key, which is furnished along with the instrument. The keeping of these instruments in working order is no easy matter, and yet every thing depends on their being in perfect condition; there are so many circumstances tending to cause a failure in injecting, that the anatomist should be enabled to depend as surely on his syringe, as the surgeon trusts to his assistant in compressing the subclavian artery in the operation of removing the arm at the shoulder-joint. The valves should be ascertained to be perfectly air-tight, otherwise the fluid to be injected will get behind the piston, and make a very nasty business of the whole affair. Experience alone will teach the injector what force must be used in the act of

injecting, and the operator must be perfectly cool and collected. The caliber of the pipe should, as nearly as possible, equal in size that of the vessel, and, when introduced, is to be secured by a turn of fine twine tied round the nozle of the pipe, the ends of the twine being brought over the lateral arms of the pipe, and again firmly tied. I set a young friend lately to inject a placenta (the easiest of all preparations to make); he succeeded very well in injecting the arteries, but in proceeding to inject the vein, he first put the syringe into the pipe fixed in the arteries which he had that moment filled. This having been pointed out to him, the syringe was put into the pipe in the vein and driven down with precipitation, probably with the view of making up for lost time. The umbilical cord had in the mean time got twisted, and the flow of the injection thus completely prevented. Down went the piston, and away went the varnish injection all over the room: the coats of the vein had given way at the twist, not an inch and half from the mouth of the pipe.

16. The coloured fluid proposed to be injected into the arteries should have certain properties, and the most essential of these is, that it should become nearly solid immediately, or at all events soon after being thrown into the vessels. If we can depend on the security of the vessels, a material calculated to become solid slowly would evidently be the most preferable, and indeed my own experience has perfectly convinced me that the *cold injection*, which possesses this property, is unquestionably the best. There are many objections, however, to its use, and we shall therefore give all the formulæ commonly in use. When the injection requires to be heated to render it fluid, the temperature of the subject to be injected requires to be raised, as nearly as possible, to that of the injection, otherwise, it is evident, the material will instantly become solid on being exposed to a reduction of temperature, and thus stop the further filling of the vessels. The attempt to force an obstruction of this kind is perfectly hopeless, and, when persisted in, always ends

in the rupture of some large trunk, the escape of the whole injection, and, in consequence of the adhesive nature of most of the fluids in use, there is scarcely a possibility of preserving the part when an extensive effusion takes place, even though we should be inclined to dispense with the filling of the vessels. It would certainly be a most desirable thing to have the vessels better filled than we generally see them in practical rooms, but the heating of the body is inadmissible; and thus nothing but a few of the large trunks are in general filled with the injection, which being commonly of a material which hardens rapidly, in the event of a rupture, does not soil the parts so as to interfere with their dissection. It should be carefully remembered, however, that the arteries, which are filled in this way are always unnaturally distended. Again, were the cold injection (sect. 24), used, unless the subject had run nearly to a state of putrescence, the vessels will offer such resistance, that they will either be not half filled, or, in all probability, if ossified, give way, and the escape of the paint into the interior give rise to serious annoyance.

17. In using the injection requiring to be liquefied by heat, it will be particularly observed (if all the vessels are wished to be filled) that the syringe, and the subject, and the injection, must all be of nearly equal temperature. The injection must, of course, be perfectly *bland* and smooth, like fine oil. Care, therefore, must be used in mixing the ingredients, and, that no knots may be in the fluid, it had better in general be filtered, for if there is a single knotty substance, the syringe will most assuredly *find* it, and thus a resistance imagined in the vessels, when in reality it exists in the syringe. The materials composing injections are mostly of an inflammable nature, and such as are materially injured by too great a degree of heat. They should, therefore, all be heated in pans immersed in boiling water, in the manner that the careful carpenter liquefies his glue. Instead of the various pigments entering into the composition of the fol-

lowing formulæ, it is evident that the size and varnishes, &c. might be simply dyed with madder, and other colouring roots.

18. With these general observations, we shall now proceed to give the formulæ of the various coloured fluids now most commonly in use. The arteries are so generally filled with red injection, and the veins with yellow, that it may be as well to continue these colours, although nothing more unnatural can well be imagined. Both colours are readily got in a very fine state of division.

Size, or Minute Injection.*

19. Take of the best glue one pound, break it into small pieces, and into an earthen pot, calculated to contain considerably more than the actual quantity of injection wanted, put the glue, and pour over it three pints of cold water; let it stand for twenty-four hours; then liquefy the whole by means of a gentle heat, and strain it through a flannel cloth. The colouring ingredient may be then slowly added, stirring all the time with a wooden pestle, so that no knots may be formed.

Red.

Size, one pint.
Vermilion, three ounces and a half.

Yellow.

Size, one pint.
King's yellow, two ounces and a half.

Blue.

Size, one pint.
Fine blue smalt, six ounces.

* This injection requires the subject, and syringe of course, to be heated; it runs extremely fine, filling every vessel into which the red blood passed during life. It is used for shewing the vascularity of the skin, bone, and all the delicate membranes of the body. The preparations made with it are generally preserved in alcohol (8) or turpentine (10).

Should more of this material be made than is required, it ought to be poured out on a flat dish (previously slightly oiled), and dried. When required again, subject it to precisely the same process as directed in preparing the size.

20. We shall suppose the anatomist wishes to understand the system of Dentition, or growth of the teeth. For this purpose the most favourable, and easiest procured subject, is that of a fœtal (slink) calf. If the fœtus is small, the injecting pipe may be introduced into the aorta; but if of considerable size, *i. e.* seven or eight months old, two pipes ought to be introduced into the carotid arteries. Great care and neatness must be used in introducing and fixing the pipes in the vessels; and if the student has not a stop-cock for each, little wooden pegs must be provided, so as to be in readiness to stop the reflux of the injection. Having prepared every thing, the subject is to be put amongst water of about blood-heat, and allowed to remain with the heat fully sustained for at least two hours. During this time the anatomist is preparing his injection, and, in addition to the size or minute injection (sect. 19), he must have prepared a quantity of tallow coloured with vermilion. These injections are to be kept in a fluid state, by being placed in warm water, abundance of which must be in readiness to keep the syringe warm. Every thing being in readiness, and the subject still amongst the warm water, the anatomist must proceed slowly to inject the size injection. The coloured fluid will probably almost instantly appear at the other pipe, in consequence of the free anastomosis of the arteries in the neck; but this pipe must now be stopped, and the injection very cautiously forced. The anatomist will be struck with the extremely small quantity of injection required, and will be regulated more by the vermilion tinge of the interior of the mouth or eyes, than the quantity of injection thrown into the vessels. As soon as a vermilion tinge makes its appearance, the size

should be changed for the tallow injection, and a small quantity of this forced into the vessels; this last will almost instantly become solid, and not only secures the size in the vessels, but pushes it into all the minute branches. The second pipe is essential for more reasons than one. It informs you, first, of the progress of the injection; and, secondly, in case any obstruction occurs, you can follow the same procedure with it as has been directed for the first. I have succeeded in injecting the head after removal from the body; but this is certainly not so safely managed, and necessitates your having an assistant quite as active and expert as yourself. In this case, as much as is possible of the cut surface must be included within tight ligatures; the foramen magnum of the occipital bone must be stuffed close with pledgets of tow, and even after all this care the size will flow from innumerable points. The syringe must just be laid aside, and the open vessels regularly secured with a ligature; and notwithstanding appearances, and the escape of large quantities of the injection, if persevered in, the object of the anatomist will in general be perfectly attained. The heat being kept up, keeps every thing in a fluid state, so that all confusion and bustle is quite ridiculous as being positively unnecessary. The injection being finished, the subject is to be placed amongst cold water for an hour or two, and then the further dissection proceeded in.

21. Varnish or Fine Injection.

Red.

Spirit varnish, eight ounces.
Turpentine varnish, one ounce. } Measure.
Vermilion, one ounce.

Yellow.

Spirit varnish, eight ounces.
Turpentine varnish, one ounce. } Measure.
King's yellow, one ounce and quarter.

Dark Blue.

Spirit varnish, eight ounces.
Turpentine varnish, one ounce. } Measure.
Blue verditer, four ounces.

22. This injection *sets* very rapidly, and requires a certain degree of heat to keep it fluid. Of course the subject also requires to be heated. Should more be mixed than is required, it will keep very well, and can be restored to its fluid state by a gentle heat, with the addition now and then of a little turpentine varnish; but I must admit that the injection is most successful when the ingredients are exactly in the proportions given above, and newly made. It fills extremely minute vessels, and is intended for parts which are to be dried, such as the *principal* arteries of the body, to shew their anatomical and surgical relations. The colouring ingredients should be previously mixed in a small quantity of the varnish with a wooden pestle, and then slowly added to the remainder, so that the whole may be perfectly liquefied and smooth. The above injection will become soft, if exposed to great heat, and would scarcely support its own weight in a preparation very minutely dissected.

23. The following injection, particularly for corroded preparations, should be used:

WAX OR COARSE INJECTION.

Red.

Bees-wax, sixteen ounces.
Resin of best quality, eight ounces.
Turpentine varnish, six ounces. Measure.
Vermilion, three ounces.

Yellow.

Bees-wax, sixteen ounces.
Resin, eight ounces.
Turpentine varnish, six ounces.
King's-yellow, two ounces and a-half.

Dark Blue.

Bees-wax, sixteen ounces.
Resin, eight ounces.
Turpentine varnish, six ounces.
Blue verditer, ten ounces and a-half.

24. Paint or Cold Injection.

The colour may be according to the taste of the anatomist, but *white* is the easiest procured, and is in every respect the best suited for this injection. All colour shops keep the white-lead prepared, *i.e.* ready ground and mixed with oil. To a small quantity of this add turpentine varnish, until of the consistence of paint, as used by painters; a very small quantity of turpentine may be added just before injecting, and lastly a little water sprinkled on the surface. It is then to be injected. It will generally require two or three hours to harden. It is evident that this injection possesses many good properties, and the most valuable is, that neither the subject nor the injection require to be heated. It can be prepared in a moment, and the whole process admits of being conducted with the greatest deliberation; vessels, if accidentally bursting, can be secured, and the syringe may be repeatedly filled. It is of course used only for preparations intended to be dried. It possesses the superior advantage over the warm injections, that the vessels can scarcely be dilated by too great a quantity being forced into them, as is the case with the heated injection, and consequently has this superior advantage, that no false notions can be taken up regarding the size of the vessels. I have often been of opinion that the enormously dilated red trunks of arteries which you see in most injected preparations are very serious objections to their use, particularly in teaching anatomy. The arteries, when seen in the course of operation, are of a white colour, having in general rather a collapsed appearance.

25. Mercury or quicksilver forms a useful material for filling certain kinds of vessels, viz. the lymphatics, lacteals, &c., which, owing to their extreme tenuity, require a pipe drawn out almost to a point, and through which it would be impossible to force any other ingredient but mercury. It has its disadvantages, however, and the principal of these is its remaining fluid after injection, and its consequent rapid and complete escape, if any lesion of the vessels should take place, which is the more likely to happen, in consequence of the vessels where this sort of injection is used, as we have before stated, being generally fine and delicate. When numerous vessels are filled with the mercury, of course the weight becomes considerable, and the tunics of the vessel are ruptured: in injecting the lacteals in the mesentery, this fact has in all probability given rise to the supposition that these vessels communicate directly with veins; the mercury having been, as is stated, found in the veins in various attempts to inject the lacteals. Many splendid discoveries, however, have been made by means of mercurial injections, and its usefulness and powers in this way are by no means exhausted.

26. The apparatus for injecting mercury consists principally of a glass-tube, fitted up with various steel pipes; they are now sold in the shops of most instrument makers. Their use requires very considerable experience, and an assistant disposed to, and capable of, *meeting* all the operator's wants. The microscope, in most cases, is required to introduce the pipe into the vessel, and the process is therefore a laborious and trying one, and will often fail, in consequence of the comparatively rare occasions on which the material is used. As the mercury will often escape in large quantities, notwithstanding every precaution, and the ready assistance of a willing hand, a tray should always be placed under the subject whilst injecting to collect and save the mercury.

27. If the glass tube, forming the essential part of the instrument used for injecting with mercury, is of considerable length, of course the force becomes very great when it is filled with mercury, being in fact proportioned to the height of the column of mercury in the tube; yet I have remarked, that the most delicate filament of cellular membrane passing along the nozle of the pipe, will stop the flow of the mercury. The operator should, therefore, allow full time for the mercury to escape, when he thinks the pipe is fairly introduced into the vessel, and move the nozle of the pipe gently up and down two or three times before making up his mind to find another vessel. The vessel must be opened to admit of the introduction of the pipe, and this is best done with the common lancet, and, when filled, secured with a ligature. In injecting the lymphatics of the extremities, and particularly the glans penis, vas deferens, parotid gland, &c., the introduction of the pipe will of course be effected very easily, but several hours will be required to allow the injection to fill the minute ramifications. As it would be a real punishment to make any one sit for this length of time simply holding the injecting apparatus, the preparation should be suspended in a glass jar full of water, the pipe secured in the vessel, and the injecting apparatus also suspended vertically of course. The tube may then be filled with mercury, and the whole left to itself, giving it only an occasional look; whilst the mercury is observed to descend *slowly* in the tube all is right. The preparations thus made will seldom admit of dissection, from the danger evidently attending the accidental opening of the injected vessel. They are in general carefully dried, and then suspended in turpentine (sec. 11); the turpentine renders the muscular or ligamentous textures semitransparent, and the injected vessels, although penetrating deeply into the centre, will be brought very beautifully into view.

28. Corroded preparations have always appeared to me

more ornamental than useful; and, therefore, more fitted for great public museums than the private cabinet of the anatomist. By means of muriatic acid, the minute ramification and beautiful arborescent form of the arteries and veins are shewn in a manner as not to be effected in any other mode of preparation. The formulæ sec. 21, 23, resist the action of the following solution: muriatic acid three parts, water one part. When the vessel, duct, or cavity, is filled therefore with either of the varnish injections, after six weeks or two months' immersion in the acid solution, all the component parts of the organ (the kidney or heart for instance) will be reduced to a soft pulpy mass, requiring merely a gentle stream of water to wash them away, whilst the injection, having the exact form of the vessel or cavity which it had filled, will remain, and thus present a very perfect model of the interior of the organ. The heart, kidneys, &c. form favourite subjects for this kind of preparation; and an extremely instructive preparation of the actual form and calibre of the urethra and bladder, in a case of stricture, may be thus obtained. The model of the interior of the urethra and bladder, however, can evidently be obtained without the use of corrosion, as the soft texture can be simply cut through, and the hardened injection turned out. These preparations, it is evident, are extremely liable to be injured, and unless the injection sec. 23 is used, any slight degree of heat will so soften the vessels, as to cause them to bend under their own weight, and thus destroy the preparation; when finished, they should be fixed on a tablet of wax, and secured under a glass shade. Great pains had evidently been bestowed by Dr Barclay's assistants in making numerous corroded preparations, but it seemed that in spite of all the Doctor's care, (and that was equal to the hen watching her chickens), they had all fallen to pieces long ere the conservatorship of his museum had passed from his hands.

29. We shall suppose the anatomist wishes to display

and preserve the arteries of the thoracic extremity. The injection should be formed of formula sec. 21, and the arm injected separately from the trunk; the pipe will consequently be introduced at a convenient part of the subclavian or axillary artery. The object of the anatomist being surgical, the relative position of the arteries his sole object, the whole dissection will consist in removing the integuments, cellular membrane, and cautiously insulating the muscles from each other, with the view of allowing them to dry, and at the same time displaying the course of the vessels. Attention to the remarks made at sec. 3, will enable the anatomist to dissect when convenient, and at the same time assist the drying process. Whilst drying, the preparation must be constantly attended to, so as to secure accurate position; and if this rule is strictly followed up, particularly when the ligaments are beginning to acquire a certain degree of firmness, all troublesome apparatuses of frame, cradle, &c. &c. may be dispensed with. If a selection can be made, the essential particularly required to make a good preparation is, entire absence of fat or oil of any kind. Should there be much fat, this must be removed entirely, if possible, during the dissection; and even with every care, the preparation will require constant attention subsequently in removing the oil, as it appears on the surface. Should the quantity of muscle preserved be great, the knife will require to be passed deeply and repeatedly into the muscles in the direction of the fibres.

30. The exhibition of the minute division of the arteries seems to have been a favourite exercise of the student of anatomy some years ago. There was in reality little anatomical knowledge required in making these preparations; and, when seen, they merely tell you that the person who made them possessed a considerable degree of neatness of hand, with patience, at least during their preparation. They possess, we repeat, little or no interest to the anatomist or surgeon.

31. The preservation of veins has not been so much the object of the anatomist as they undoubtedly deserve, and I have often thought of making a complete series of preparations of veins *where implicated with surgical operations*. Their injection has, with few exceptions, to be made from the extremities towards the heart; and it is plain that the deep veins alone admit of being preserved as dried preparations; thus an accurate knowledge of the arteries necessarily includes a pretty accurate knowledge of the veins, as the deep veins very nearly accompany the arteries. In most operations on the arteries, however, a knowledge of the position of the veins and nerves is essential; but no surgeon will now deny that, to operate *safely* and successfully, the surgeon must all his life be as it were a student, the oftener he has the scalpel in his hand the better. In the operation for popliteal aneurism, for instance, it would be disgraceful for the surgeon, and probably fatal to the patient, if the operator required a dried preparation to tell him the exact relative position of the superficial femoral vein. Indeed, if he did not know this, it is more than certain that he will require to be informed that such a thing as the *sheath* of the vessels (and which a dried preparation will *not* shew) ever existed. The superficial veins are best studied on the living body; casts in plaster of Paris are often made of the veins, and even get into anatomical collections, but for what purpose it is difficult to say.

32. Regarding the injecting and preparing the lymphatics and lacteals, we have little to add, in addition to our remarks contained in sections 25 and 26. A very minute knowledge of anatomy is required to find either system of vessels; when a successful injection has been made, the preparation must be dried and preserved in turpentine, sec. 11. Yet I should recommend every anatomist who feels anxious for the advancement of physiological science, to be possessed of, and be as familiar as

possible with, the necessary apparatus required for mercurial injections; there cannot be imagined a readier and safer mode of ascertaining the course of any minute vessel which may occur in anatomical investigations. The farther examination of the part is not in any shape interfered with by the use of the mercurial injection, as, though it may escape in great quantity, it soils nothing.

33. The system of vessels called Lacteals, in a physiological point of view, have the deepest interest. They are known as branches, as it were, of the thoracic duct, communicating with the mucous membrane of the intestines, and are consequently found between the layers of the mesentery. Unless filled with chyle, which they are known to convey from the interior of the intestine to the thoracic duct, they are perfectly transparent and invisible in the human subject. They must be looked for, even in the seal, porpoise, horse, &c. where they are, comparatively speaking, large, with a magnifying-glass. The vessel must be opened by perforating one layer of the mesentery and the tunics of the lacteal itself, and in consequence of numerous valves the injection must flow towards the thoracic duct. All these circumstances render preparations of the lacteals by no means common, or even often attempted. Two cases are on record where the valves were found not present, so that they admitted of being injected from the thoracic duct. I have often thought that this circumstance may not be so uncommon as is supposed, and should recommend a small quantity of the injection, sec. 12, to be injected in all cases where the thoracic duct can be reached previous to extensive dissection of the viscera. The latest mode suggested of displaying the lacteals, is that of filling to distension, a small portion of the intestines with milk, and then forcing the fluid into the lacteals; this experiment has never been successful, so far as I am aware, except with the viscera of a sheep, taken immediately after the animal has been destroyed. These animals are killed

when in full health, and after having been deprived of food for many hours, so that the whole system is placed in peculiar circumstances, and such as we never by any means find the intestines of other animals placed in, except in those made the subjects of experiment.

34. The nerves are preserved in museums in general as wet preparations, according to sects. 6, 7, 8, and 9; and I rather think it is the only true way of preserving them. They are not difficult to preserve by drying after the preparation has been long immersed in alcohol, but they shrink much, and dry of a blackish colour, requiring paint, the most objectionable process which can well be devised. A solution of the oxymuriate of mercury is well known to possess very powerful antiseptic properties, and also to facilitate the subsequent drying. It destroys all colour, however, and the recommendation of its employment to the beginner is unpleasant to the feelings, owing to its fearful poisoning effects, and the trouble and care essential in its use. The brain itself, however, may be hardened and dried by the solution in the following proportions:—

35. Oxymuriate of mercury, one ounce,
Muriate of ammonia, thirty-five grains,
Water, one pint;

the mercury and ammonia to be rubbed together in a mortar, and the water added gradually until the solution is complete. The part under preparation (a brain for instance) will require a fortnight's immersion, but may be completed in a shorter period by substituting alcohol for the water. Should a white precipitate be thrown down during the immersion of the preparation, it must be removed by allowing a stream of water to flow over it; and this must always be done previous to finally drying, as, should any of the solution remain on the surface, crystals will be formed in abundance, which cannot be removed after being dried. Abundance of varnish and

paint must follow the use of this solution, as all textures are reduced by it to one uniform colour.

36. The above solution, of half the strength, possesses sufficient antiseptic power to prevent the progress of putrefaction, but the dissector's hands and knives will still suffer severely, unless from time to time coated with oil. I have hitherto avoided the use of this antiseptic, even in preparing the nerves, a proper knowledge of which can only be attained by actual dissection, and the labours of preceding anatomists in this branch of the science, in making dissections and giving accurate engravings of these dissections, leave little to be desired. The use of the solution in preserving vascular and other preparations, is quite out of the question. In selecting parts of animal bodies for the purpose of making anatomical preparations, the great leading fact to be kept in view is, that oil will *not* dry, use what antiseptic you please, and, therefore, the subject must be free from fat or oil; if it is so, then no *poison* or other ingredient is required, but all that is necessary is to dry it. The use of any thing requiring paint must for ever render it a most dangerous and improper material for anatomical purposes, excepting, perhaps, the preparation is intended for the private cabinet of the surgeon; its introduction into museums would very soon render all vascular preparations not worth looking at, and indeed most dangerous objects for the study of the beginner. I reckon it quite impossible that the surgeon, removed from hospitals, and, consequently, the means of practical instruction, can by any means keep up his knowledge of the anatomy of the body, and the attempt to do it by means of a few dried mummies is truly, to say the least of it, laughable. Nay, in my opinion, instead of assisting the mind, such preparations must tend to destroy the surgeon, as it is probable he will remain satisfied with their inspection; and when called upon to tie the humeral artery, for instance, which he may have punctured in phlebotomy, he will think of his preparation at

home, where the artery is distended to twice its natural size, and *painted!* of a bright shining vermilion colour, and with this phantom flitting before him, I could almost imagine his putting a ligature on the *humerus* instead of the humeral artery. When a surgeon is so situated as not to have it in his power to dissect, I observe his operations get fewer and fewer, and it is a happy thing to reflect that the disadvantages to the community is nearly counterbalanced by the advantage of possessing a *non*-operating surgeon, instead of a *cutting* one. I recollect of a practitioner in the town of Dunbar, where hernia is as common as in other places, stating that, in thirty years practice, although called upon for his aid very frequently in cases of strangulated hernia, he had *never* once operated, and *never* had lost a single patient, having always been successful in reducing the hernia by means of the taxis. Within these few weeks I have seen two cases operated on, for strangulated hernia, and both terminated fatally, and I must say, that the impression made on my mind by the death of these two, apparently healthy, women, is most unfavourable to the *cutting* surgeon. I am quite certain, for many other reasons, which it is unnecessary here to detail, that preparations which have been *painted* and *varnished* can never be of the slightest use to the surgeon, and are only fit for filling up the more inaccessible corners of an extensive public museum. Preparations of the nerves are more curious than useful; I allude more particularly to the minute distribution of the great nervous cords. They are most interesting to the anatomist and the physiologist, but not of so much importance to the surgeon as to induce him to fill his private house with mummies.

CHAPTER III.

37. Of the skeleton—Difficulties of procuring and preparing in Britain.—38. State of the bones proposed to be cleaned.—39, 40. Macerating process when the bones are in a favourable state.—41. Other circumstances favourable for maceration.—42. Unfavourable circumstance.—43. Cleaning bones which have become soiled.

37. The anatomist in Great Britain will find it no easy matter to prepare, under his own special care, the *perfect* adult human skeleton. Almost insuperable difficulties have existed time immemorial, and, what is sufficiently distressing, still exist, to preparing this most essential preparation. At this moment it is actually contrary to the express letter of the law to make any such preparation. In 1824, when the author became assistant to his Brother, then engaged in forming, and conservator of, the Anatomical Collection belonging to the Royal College of Surgeons, there was not a single healthy bone in the collection. The bones of the head separated had, a short time previously, been sent from Paris by a gentleman then in the pay of the College. These very bones were ultimately required by the same gentleman, for the purpose of illustrating his course of lectures, so that the collection was again rendered completely destitute of the bones of the human skeleton. In these circumstances no time was lost in preparing an entire adult skeleton, and the attempt was eminently successful, the skeleton being unquestionably still the finest in the collection. The difficulties we have alluded to are not entirely confined to

the want of materials. The climate acts, and will of course continue to act, as a preventive.

38. The essentials required to enable us to procure a perfect preparation, are, first, the bones must be sound, *i. e.* free from any pathological condition, and some lingering disease must have been the cause of death, so that the medulla, whose membrane enters into the minute cells of all the bones in a state of health and vigour, shall have been completely absorbed previous to death. The age must be above twenty, and not exceeding forty.

39. Having procured a subject of this kind, the viscera may all be advantageously appropriated for the cabinet of the anatomist (the mode of preserving which will be found under their respective heads). Having removed the viscera, and, if convenience admits of it, taken a view of all the various regions of the body called surgical, the anatomist will proceed to separate the subject at the following articulations, viz. The atlanto-occipital sterno-clavicular, right and left; ilio-femoral, right and left. The subject will now be divided into six portions, and can be put into comparatively a very small sized macerating tub, or the extremities might be put into one, and the trunk and head into another; this will be attended with the advantage of enabling the anatomist to select the bones with greater ease and safety, when the progress of maceration shall have completely denuded them of all the investing soft parts. The macerating tub should be a barrel, fitted with a close secure cover, and capable of containing three or four gallons of water more than what completely covers the subject. The anatomist will take especial care to remove few or none of the muscles, particularly, not to attempt, on any account, to expose the bones. For the first week the water will be tinged with blood, and ought to be completely changed every day. The muscles will now assume a soft bleached appearance, and the water will be but slightly tinged. The barrel should now be filled, for the last time, with pure

soft water, and then closed. Supposing the situation to be a back area or cellar, the preparation had better not be looked at for six weeks or two months. The process, if to be completed in Great Britain, in the open air, and without the assistance of any artificial heat, will only succeed during the months of June, July, and August. Should the effect of putrefaction not be complete in six weeks, no effort will ultimately produce an unexceptionable skeleton; for if continued after this time, adipocere will to a certainty be deposited, and from the commencement of the appearance of this deposit, the bones themselves break up and rot.

40. The macerating process being completed, the bones must now be collected, with great care and patience, from amongst the putrid remains; and, indeed, this will require to be done by a person perfectly acquainted with all the bones of the body, so that he may name each as it turns up to him, and place them immediately in dishes of pure water, each section in a separate vessel; by this means he will be quite certain when he has got the entire skeleton from amongst the putrescent remains. Having washed the whole with a nail-brush, soap, and abundance of pure water, they should be put into a very dilute solution of the aqua potassæ, or a weak solution of ammonia, in which they may be allowed to remain for a week or ten days. A current of water should then be allowed to play over them for half an hour, when they are to be placed in a clean tray, carefully wiped with a linen cloth, and allowed to dry slowly, by being placed in a current of air, but excluded from the sun's rays. They ought to be turned over repeatedly whilst drying, and at each time wiped with a linen cloth. In this process the anatomist will remark, that the bones have never been touched with a knife or any sharp instrument; but we have now to remark, that this can only be avoided when the subject answers the precise description we have given at the commencement of this article. Should

the subject be under fifteen it must be subjected to a totally different kind of procedure; and if above forty, however thin and emaciated, oil in considerable quantities will, at all events, appear on the long cylindrical bones, as the humerus, femur, &c., and they will require to have their extremities pierced, and water injected through them, before the process of maceration is commenced. Even with an unexceptionable subject, the anatomist will carefully observe, before the bones are put to dry, that no oil appears on the surface; that they are neither too heavy nor too light; for, should the slightest appearance of oil be observed, the strength of the potass solution must be increased, the water renewed, and, if nothing else will do, an opening made at each end of the long bones, and water injected repeatedly through them.

41. A great variety of means may be resorted to, to procure, in a state fit to be preserved, the osseous system not only of man but of other animals. In a warm climate, or with the aid of a steady artificial heat, the process of putrefaction is greatly expedited, and may be completed in ten days or a fortnight, and with advantage to the preparation. The bones of the larger quadrupeds, such as the horse and cow, can be cleaned with great success by being buried in an ample collection of manure, formed of the refuse of the stable. The quantity of manure must, however, be in sufficient quantity to *heat*, and the process should be completed in a few days, as if allowed to lie long, in consequence of a low temperature, the bones will rot, and large quantities of adipocere will be deposited. A solution of the chloride of lime acts powerfully in whitening bones, but it requires great caution in its use, as it acts, if strong, on the bones themselves. Should any disagreeable effluvia arise from bones after being cleaned and dried, they should be washed in the solution of the chloride of lime, which will most effectually remove it. We often see finely bleached bones on the sea-beach, and this fact has suggested the possibility of using this

means for procuring skeletons. So far as my own experience goes, however, this attempt would fail in more ways than one; first, no one would ever think of risking a valuable skeleton in a situation where there is evidently so many chances of parts at least being carried away; secondly, the bones I have picked up are, like the generality of shells, worn, and therefore perfectly useless to the correct anatomist; and, lastly, these bones, although white when first found, on being kept invariably become of a very dark colour. I can readily perceive, however, that the sea-side would be an admirable place for bleaching bones, but they would require to be protected from the action of the tides, and merely have the sea-water repeatedly sprinkled over them; but spring water *in the country*, where the air is not impregnated with soot and smoke, will answer quite as well as the sea-side.

42. Should the soft parts have been removed extensively, it will be found scarcely possible to clean the skeleton, more especially if the bones want those essentials to which we have alluded. The putrefactive process would in all probability never properly commence, but adipocere would be formed in abundance. I have, under these circumstances, resorted to boiling them for five or six hours in a strong solution of pearl-ashes, and if the texture of the bones is sound, very fair specimens can thus be procured.

43. Should the skeleton in process of time get soiled, and perhaps exhibit signs of the remains of oil, it should be boiled in a solution of pearl-ashes and water for an hour or so, washed with a good brush and soap, and dried as directed sect. 40. All bones acquire a great degree of density after having been dried, apparently, as I think, in consequence of the slow but sure contraction of their cartilaginous bases, so that a good sharp boiling does them little or no harm.

CHAPTER IV.

44, 45. Use of the skeleton to the student.—46. The crania of all animals most useful.—47. Process for procuring the bones of the head separate.—48, 49. Horizontal section of the cranium.—50. Vertical section.—51. Tympanal bones.—52. Mechanism of the pars petrosa.—53. Section of the inferior maxilla.—54. Mode of displaying the diplöe, and veins of the diplöe.—55. Cancelli of bone.—56. Medullary cavity and structure of long bones.—57. Parenchyma of bones.—58, 59. Vascularity of bones.

44. Under its proper head, full details of the mode pursued in articulating the skeleton will be given. It has always appeared to me, however, that the articulated skeleton was by no means so useful as the separate bones of the skeleton, with all their articular surfaces entire.

45. The bones of the head are articulated naturally, in so curious and beautiful a manner, that a little artifice is necessary to separate them, although the soft parts, including the investing periosteum, may have been completely destroyed by maceration. The bones composing the head have not been described by anatomists separately, with the view of rendering the description difficult, as most *students* of anatomy seem to think, but in reality with the view of rendering the anatomy of this most important region more simple. The present high fame of the continental anatomists, rests nearly altogether on their having viewed the development of the skeleton, (particularly the head), not only with the minute detail of the practical mechanic, but with the splendid and sweeping generalizations of scientific views, founded on a minute or microscopic view of the elementary component parts.

46. In illustration of what can be done by a careful examination of the bones composing the head of animals, I refer to Cuvier's Fossil Remains; where nearly all the deductions drawn, and inferences made, have a reference to the cranium. Without an acquaintance with museums, however, and familiarity with texture, acquired either by actual manual manipulation, or consulting some practical work, it will be found extremely dangerous, if not impossible, to follow Cuvier's route. In the autumn of 1834, when the town was visited by a number of strangers, a gentleman, examining our own private museum, was evidently in pursuit of some particular object; I asked him what it might be, and he informed me that, in dissecting some rare specimen of monkey, he discovered that the animal wanted *inter*-maxillary bones; and he had come to the strange conclusion that, instead of a monkey, it must have been a man. I immediately shewed him a dozen specimens of human crania with *inter*-maxillary bones, and the gentleman became so confused, and no doubt unhappy, at having his wonder dissipated, that he quickly took himself off, and I saw no more of him.

47. The various bones described by teachers of descriptive human anatomy as entering into the composition of the human head, are extremely difficult to be procured in a perfect state. The reason of this seems by no means very generally known, or at all events understood. From the commencement of fœtal existence until extreme old age, the human cranium is constantly undergoing changes; and the leading feature of these changes is the union of its component parts, and an increase in their density. There seems no very fixed laws regulating the union of the different portions, either with regard to succession or the period when they do unite. Generally speaking, however, the present nomenclature of the osteology of the human body, seems to have been drawn from the skeleton of a person of about twenty or

twenty-five years of age. To procure the separate bones of the head, however, the subject must not exceed twenty, nor ought it to be a single year under this age. If younger, the bones will be incomplete in every respect; the important sinuses in the sphenoid, ethmoid, and frontal, will in all probability not have formed; whilst, if much beyond twenty, some of the bones will have united to others in such a manner as to require a destructive process to disunite them. For all useful purposes, the bones separated, although not all belonging to one subject, are perfectly good, more particularly as most of them are so delicate as scarcely to admit of being handled, so that any attempt to put them together in the style of the schoolboy's map of the world, is entirely out of the question; each bone must be studied by itself, so that certain sections (which we shall also describe) must be procured. Should the anatomist meet with a favourable subject, the mode of separating the bones is as follows:—

48. The head is, in the first place, to be cleaned, according to the rules laid down sect. 39; should the dura mater resist the process of putrefaction, *so much the better*. Before being allowed to dry, the interior of the cranium should be stuffed quite full of dried pease, by the foramen magnum of the occipital bone, into which a portion of dried sponge had also better be stuffed, so as to prevent the escape of the pease; the head so filled should then be put into pure fresh water. The pease will almost immediately begin to swell, and will generally separate at least all the great sutures. A cautious, delicate, and experienced hand, will then examine the work done by the pease, and, unless permanently united by bone, will succeed in detaching the small bones of the face from each other, upon which the pressure of the pease from within could of course have no effect. Should a permanent union of any have taken place, no mechanical or violent measures should be used

to effect the separation, as the union may in truth form a more useful preparation than the perfectly separated bones. The process of bleaching and drying these bones will of course be precisely as previously detailed, sect. 40. They should be preserved in a case, divided into as many compartments as there are bones, and on no account put amongst wool or any such material; but, if required to be carried from place to place, wrapped lightly in fine cambric paper.

49. Sections of the human cranium can of course be made either before or after the preparation shall have been cleaned and dried, but by far the best are those made previous to *maceration*. The anatomist positively requires to see at least two sections of the cranium, viz. the horizontal and vertical sections.

50. The horizontal section may be made as follows: a knife should be passed round the head, dividing every thing down to the bones, so as to mark a sure line, immediately to be followed with the saw. The line should commence about half an inch above the superciliary ridges, passing round the sides of the cranium about an inch below the external occipital protuberance. The object is to remove as large a skull-cap as possible, and yet have the base of the cranium entire. Should the dissection of the brain not be an object, a fret-saw will be found the most convenient for making this section.

51. The vertical section should also be made with the fret-saw. The anatomist must avoid the precise mesial line, inasmuch as he would thereby destroy (however fine the saw may be) the vomer or azygous bone, forming the septum between the right and left nostrils. The section should therefore be commenced immediately over the internal incisive tooth of the right or left side, the tooth having been first carefully extracted, and the saw then directed through every thing, keeping it close, but at the same time free, from the vomer. This section will illustrate, in the most satisfactory manner, the way in which

the nostrils are divided mesially, and at the same time the composition of the different meatuses; preserving also the ridges internally forming the osseous part of the various sinuses completed by the dura mater, in other words, the venous circulation within the cranium. The true or inferior turbinated bones will invariably be found loose, however aged the subject; and after the maceration of the preparation, must be searched for amongst the debris, and fixed in their proper position. This section will also display the ethmoidal and sphenoidal sinuses; and both the horizontal and vertical sections may be so united as to be equally useful as the entire cranium.

52. The tympanal bones in man are four in number, placed within the cavity of the tympanum. The *meatus externus* is of such a size in man, as, when the *membra tympani* is destroyed by maceration, the whole four tympanal bones may escape from the interior, and will not be readily found amongst the putrid soft parts. They will require, therefore, to be picked out previous to subjecting the head to the stream of water used in finally washing the preparation. Should the *malleus* (the most external of the four) be found in situ after the brain has been cleaned, and the membrana tympani destroyed by maceration, in all probability the process named the "long process of Raw" adheres to the walls of the glenoid fissure, into which it extends, and will to a certainty be broken off in any attempt to remove it. It is a singular fact, that these small but interesting bones are amongst the first osseous parts which appear in the fœtus, and have attained their full development at a very early age; they should, therefore, be taken from the young head.

53. The temporal bone is unquestionably the most interesting of all the bones composing the skeleton. It has received, and well merits, a most minute description in all works on descriptive anatomy. The *pars petrosa* in the adult skeleton forms only a portion of this interesting bone, and the dissection of this portion is essential to the

right understanding of the sense of hearing. Indeed, in all lectures on Anatomy and Physiology, the lecturer demonstrates the soft parts merely by pointing out the various cavities, canals, &c. observed on the perfectly macerated temporal bone. By far the best dissections of this bone which I have seen are made in Paris; where the abundance and choice of subjects, added to the very superior surgical instruments, and the natural neat mechanical turn of the inhabitants, seems to combine in producing preparations of the osseous system generally, of which we in Britain have no conception. Superior as these sections are, however, I should recommend to the student who wishes to master the anatomy of the temporal bone, to provide himself with a small handy drill, made to fix on his bench or table, and a good fine rasp or two. Having previously, with a pencil, drawn in outline the portions of bone he wishes to preserve, with the drill he will be able to remove without fracture the parts wished to be removed, and thus insulate the semicircular canals. The cochlea, vestibule, mastoid cells, &c. can be readily exposed with the rasp. The whole of the temporal bone may be softened by the muriatic solution, section 28, and by the addition of alcohol the soft parts preserved, when the dissection of these may be made with ease, the osseous textures being so soft as to be cut with a knife.

54. The anatomist, in order to understand the manner in which the teeth are placed in the jaw, and how the pulps are supplied with bloodvessels and nerves, should see the interior of this bone. A good rasp will remove the external surface to what extent he deems proper, and will display the whole course of the inferior dental canal.

55. To see the diplöe placed between the outer and inner tables of the skull; the outer table must be removed by means of a good and *fine* rasp. If the anatomist wishes to see the veins of Santorini, the removal of the outer table should be commenced near the central

part of the parietal bones; the process must be conducted with some caution, and each application of the rasp followed by a good nail brush, otherwise both tables and diplöe may be got through without discovering the veins. To make a good preparation of these veins, the bones must be perfectly macerated, dry, and free from oil.

56. A longitudinal section of the femur will display the great medullary cavity peculiar to the long bones, and the cancelli of bones generally: the bones selected for this purpose must be that of a young person, answering all the requisites insisted on in section 38.

57. The parenchyma of the osseous system will be best understood by the following processes. Any bone (the scapula is the best) either in a recent state, or after having been dried for any length of time, must be put into an acid solution, composed of the muriatic acid, in the proportion of three drachms of the acid to a quart of water. The jar must be a glass one, and merely large enough to hold the bone completely covered with the liquor. Attention will be required, so that the *acid* absorbed by the earthy matter may be renewed cautiously, and the effects of evaporation supplied, so that the bone may be kept constantly covered. From three to six months will be required for the completion of the process, when the bone will be found perfectly flexible and soft, resembling a portion of cartilage; it should be allowed to lie in pure water for a day or two, and then put into a jar, the body of which shall be fully the size of the largest dimension of the bone, whilst the neck may be not more than the diameter of the thickest part of the bone. If a rib is thus treated, it may be rolled up, or have a knot tied on it. The temporal bone, when subjected to this process, may be cut with a common scalpel. When put into a proper jar, the scapula, for instance, may be rolled up, so as to pass the narrow neck, but when in the jar, will expand and resume its original shape and size; upon the jar being filled with proof spirits, the scapula be-

comes of a pure dense white colour, and looks precisely like the perfect scapula. This mode proves the bone to be formed of an elementary cartilaginous basis, having the exact form and size of the perfect complete bone. The acid has removed the earthy portion.

58. The second process is to subject a bone to an intense white heat, when the cartilaginous basis, uninjured by the weak acid, as seen by the preceding process, will be driven off, and the earthy portion will remain; this will also be found to retain the size and form of the original perfect bone, but of extreme lightness and frangility, and so perfectly dry, that the largest bones in the body thus prepared will adhere to the tip of the tongue.

59. To exhibit the vascularity of bones, the injection used must be the size injection, sect. 15, and the process conducted with the greatest care. It will only succeed in young subjects; and even then, in all probability, the larger branches of the nutritious arteries may alone be injected. The bones derive their supply of blood either from innumerable bloodvessels transmitted into the osseous texture through the periosteum, or from branches proceeding from those arteries called Nutritious, which pass as one or more considerable trunk or trunks into the central parts of all the bones, and are considered as distributing their terminating branches on a membrane called medullary. This membrane lines the interior of every cell, however minute, and the bloodvessels upon it are of course extremely delicate. Most preparations of this kind which I have seen in museums evidently consist of mere effusion of the injected material into the cobweb net-work of the medullary membrane; the injection taking the place, as it were, of the medulla. The periosteum is commonly directed to be stripped off, but it is clear that, by doing this, the periosteal vessels will either be cut across, or drawn out of their microscopic osseous canals; and I suggest that this membrane should be carefully left, the bone softened by means of the acid solu-

tion, sect. 56. dried, and then put into turpentine, and, if for a public collection, the fact of the periosteum having been left, particularly stated in the Catalogue.

60. It is known that the bones of the human body are at first cartilaginous, or apparently so, and that the commencement of the osseous deposit or change, is indicated by the appearance of vessels carrying red blood generally into the centre of the cartilage. These enlarged vessels will, of course, readily admit of the passage of the minute injection, sect. 15, but in such minute quantity as not to be observed until the part has been completely dried, and immersed in turpentine. I caution the anatomist, therefore, in injecting with the minute or size injection, not hastily to throw away any part, under the impression that the injection has not penetrated, but to proceed with the same care in dissection as if it had done so; should it turn out that the injection has failed, the preparation will still recompense his labours, as every thing connected with the growth of the skeleton is most interesting, and *good* preparations are as yet extremely rare.

CHAPTER V.

61. Articulation, general remarks on.—62. Mode of articulating the spinal column.—63, 64. Pelvis, ribs, and sternum.—65. Pectoral extremities.—66. Radio-cubital articulation.—67. Wrist-joint.—68. Elbow-joint.—69. Sterno-clavicular articulation.—70. Pelvic extremities.—71. Knee-joint.—72. Ankle.—73. Foot.—74. Position of the human skeleton.—75. Skeleton of quadrupeds.

61. A VERY lengthened article might be given on the artificial articulation of the skeleton; but I would remark, in the first place, that no instructions will entirely supply the want of a little practice. The various cutting instruments in use by carpenters are all in constant requisition, and few or none use these to much purpose without some experience. We shall suppose, however, that the anatomist who purposes articulating a skeleton, has acquired some facility in the use of the necessary tools; and shall now proceed to supply such hints as, I trust, will save him many a hard day's work.

62. The skeleton being clean and perfectly dry, should be spread out on an ample bench or table, and arranged so that no mistake may by any chance be made in uniting the bones; for it should be recollected that any bone being destroyed cannot be replaced by another, and that many of the bones must be subjected to as little manipulation as possible. The leading object must be to conceal as much as we possibly can the connecting material (viz. the wires and tin-plates), and also always to use these materials of a proportioned strength to the skeleton or bones to be articulated,—avoiding an unnecessary degree of strength, and yet preserving perfect firmness. The concealing of the articulating wires may also be car-

ried too far, and the skeleton thus reduced to mere shells of bone, which will fall to pieces in any one's hand who may afterwards have to move and reput-up the preparation. In determining upon the form the skeleton is to assume, that of perfect rest should in general be preferred, and no fantastic attitude assumed, such as "men riding on horses," "cats and dogs fighting," &c. With the exception of the human skeleton, the anatomist should never attempt to preserve the motion of the articulations, as bones will not admit of this to any extent.

63. We shall suppose that the anatomist wishes to articulate the bones of the human skeleton. Having first arranged the spinal column, the bodies of the vertebræ composing it are each to be perforated in the centre, so that an iron-rod of the thickness of two-eighths shall be passed through the whole of them. The seldomer the anatomist has to apply to the blacksmith for his assistance the better, so that he ought to be provided with a small vice, and accustom himself, with the assistance of a pretty heavy hammer, to fashion the iron-rods to his his own taste. The expense of employing a workman is not so much a consideration, as the difficulty of getting another to understand exactly what you want executed. Delays also take place which will often cause the golden moment to pass, never to return. The extremity of the iron-rod we have alluded to should be softened by being put into the fire, and, whilst hot, with a strong pair of round pliers, a neat eye formed on it, and beat quite flat; this, by being again heated, and then suddenly put into cold water, will be sufficiently tempered for the purpose. A transverse slit extending to about an inch into the centre should be made, by means of a fret-saw, in the *base* of the sacrum, calculated to admit of the extremity of the iron-rod with the eye on it, and a firm iron pin passed from the anterior aspect of the sacrum through the eye in the rod. Between the base of the sacrum and the body of the fifth lumbar vertebra, there exists during life an inter-articular substance, separating them to the

extent of half an inch anteriorly, but not so much posteriorly, forming thus what is called the sacral angle, and being continued in the four or five succeeding intervertebral spaces, produce a considerable convexity anteriorly, or towards the abdomen. A successsion of portions of cork,* formed to imitate this curvature, must be introduced between each vertebra. The curvature begins about the 7th and 8th dorsal vertebræ to be reversed, so that in the thoracic region we have a curvature, but the concave aspect is towards the thoracic viscera. The distance between each vertebra is also greatly less, so that the thickness of the cork must be much diminished. The spinal column again changes its curvature, so that the cervical region becomes slightly convex anteriorly. These curvatures must be particularly attended to whilst thus constructing the column; and by forcing each vertebra *firmly home*, and observing that the articular processes of the one meet those of the other, the manner in which these articular processes lock into each other will prevent the spine straitening itself, although afterwards exposed to hard usage. The spine, thus formed, constitutes one of the most useful preparations an anatomist can possess.

64. The pelvis should now be completed, by uniting the two ossa coxarum to the sacrum. The pubic articulation should be carefully and firmly made so as to preserve the proportions of the pelvis: the articulation must have a thin portion of cork introduced, and two transverse portions of soft wire passed through from side to side, including the cork; these wires are to be twisted together, but not until the union of the ossa coxarum with the sacrum is completed. The anatomist, having placed both ossa coxarum and sacrum in perfect apposition at the sacro-iliac articulation, will, by means of a

* Cork of various thicknessss, dressed and cleaned, can be got at any corkcutter's, and the anatomist can, with a common shoemaker's knife (kept sharp), and a little oil, fashion, with the greatest ease, the cork to his own purposes or taste.

common brace and bit of sufficient length, pass through all three bones together, and follow this perforation with an iron-wire of proper length, previously prepared with a nut and screw, on each extremity. This, with pins passed into the bones in opposite directions on each side, will make a very strong articulation. Having ascertained that the proportions of the pelvis are preserved, the wires previously passed through the symphysis pubis may be now firmly twisted together. I may remark, that the transverse iron-wire and nuts may be dispensed with, if the preservation of the pelvis *alone* is required. In this case stout copper-wire, or soft malleable iron-wire, passed through the bones in opposite directions, and a neat eye formed on the projecting ends, forms a compact and very strong articulation, with the additional advantage of not injuring the bones.

65. The articulation of the ribs to the spine is a troublesome part of the process, and requires considerable patience, as, if done slovenly, the chest may not only assume an extremely unnatural form, but will of course mar the look of the whole skeleton. The articulation of the ribs to the spine must be commenced with the inferior ones, beginning with the twelfth, and terminating with the first. A variety of kinds of articulation may here be adopted; but the mode which has always seemed to me the best, is that which does the least injury to the bones. I apply the two articular surfaces to each other, and, with a drill the thickness of the wire which I purpose to follow it with, I make a hole in the direction where I have the firmest and thickest bone. The wire being thus passed through both bones, and cut short, leaving only sufficient of each extremity to enable me to make an eye, which had better not be closely formed until the following articulations are made: good copper wire is perhaps the best for this purpose. The French skeletons are extremely well articulated, and those I have seen have had the natural cartilages of prolongation (*sterno-costal*) pre-

served. We know, however, that these cartilages lose a great deal of their bulk and natural appearance by drying, and I have always preferred an imitation. These may be either composed of narrow strips of sole or sadler's leather, which, by being wetted, will dry in any form given to them; or the following plan (which I think fully preferable) may be had recourse to: Seven portions of malleable wire, of a proper length, are taken and passed through the sternum, in the situations where the sterno-costal cartilages joined that bone; these are to be brought successively to the sternal extremities of the ribs, and fashioned so as to resemble the form of the natural cartilages. The sternal extremity of the ribs will be found to present an unfinished-looking cup-shaped cavity, and the centre of the rib being composed of cancelli, is to be scooped out to such an extent only as to allow of the extremity of the wire, on which a neat eye has been formed, to pass into it. Two soft and rather slender wires are to be connected to the transverse processes of the fifth or sixth cervical vertebra, twisted neatly together until they reach the first rib, a hole having been made near the sternal extremity of the rib, in such a manner as to be continuous, as it were, with the eye made in the sterno-costal wire; the wires twisting from the neck will be passed through the hole, crossing each other in the passage through, encircling the rib, and also completely fixing the sterno-costal wire. The same is to be repeated with all the ribs, and the twisting wires connected with the transverse process of the second lumbar vertebra. Some finely carded tow is now to be taken and spread out into long slips, like ribbons, of about an inch in breadth; these are to be covered with strong paste, and rolled firmly round the sterno-costal wires, until they assume the size and form of the original cartilages; considerable neatness is essential in this part of the process. A good glazier's knife is required to spread the paste on the tow, and afterwards to

smooth the whole when rolled on the wire; when well done, nothing which I have seen looks and lasts so well.

66. The arms, or pectoral extremities, must now be articulated, and although no ingenuity can, or at all events has hitherto, succeeded in imitating the movements of the chest and spine, the joints of the extremities certainly admit of imitation to a very great extent. A screw, of the thickness of about two-eighths, and two inches and a half in length, flattened out at one extremity, with a small hole in the centre, and provided with a pretty thick square nut, fitted on the screw extremity, will require to be made by a smith to order. A saw must be carried in an oblique direction across the head of the humerus, to about an inch in depth; into the fissure thus made the flattened end of the screw must be passed, and secured by means of a pin passed at once through the bone and the hole in the screw. A small mortice is then to be cut in the inner surface of the neck of scapula, about a quarter of an inch from the glenoid cavity, and of sufficient depth and form, so as to admit the nut into the centre of the bone; this nut will be kept in its place, and concealed, by a little flour-paste, or tow and paste. A hole must then be made in the centre of the glenoid cavity, in a line with the centre of the nut, so that the projecting screw, previously fixed into the humerus, may be screwed into its nut, thus buried, as it were, in the centre of the neck of the scapula. This kind of articulation will admit of very extensive circular motions, is extremely secure, and admits of the extremity being separated and replaced at any time with great ease.

67. The radius is articulated with the ulna, at its proximal and distal extremities. Two oblong portions of tin-plate, about one inch in length by one-quarter of an inch in breadth, having one extremity rounded and the other straight, are to be procured, and the object to be kept in view, is the rotation of the radius on the ulna. To effect this, the square extremity of one plate is to be firmly

fixed into the ulna at the radio-ulnar proximal articulation, and the other plate fixed in a similar manner into the radius in the radio-ulnar distal articulation. The rounded ends of the tin-plates will project transversely; and, it will be observed that the proximal corresponding articular surface in the radius is circular, and that on the distal extremity of the ulna is also circular. A fine saw is to be carried, in a transverse direction, across the central part of these two circular articular surfaces, so as to receive the articular projecting extremity of the two tin-plates; these are to be secured by appropriate iron pins, which become a kind of central point on which the radius is made to rotate.

68. The eight carpal bones, and the four metacarpal bones supporting the four fingers, may all be connected together, without attempting much motion between any of them. Slips of tin-plate, about a quarter of an inch in breadth, and one or two inches in length, should be attached to the proximal extremity of the four metacarpal bones, and, by means of a small fine saw, slits made through the corresponding articular surfaces of the carpal bones which will admit of the slips of tin-plate, and fixed with small pins passing through the tin plate and bones; the plate should be perforated by a drill whilst in the bone. The thumb and phalanges of the fingers should be articulated, so as to admit of flexion and extension, and one sort of articulation is applicable to the whole. These bones have all, with the exception of the distal, or that supporting the nail, a concave and a convex extremity. Into the concave extremity a slit must be made with a fine saw, and a delicate tin-plate fixed firmly and immoveably into it by means of a small pin, passed latterly; the projecting extremity of the tin-plate must be rounded, and a fissure made in the corresponding convex extremity of the other bone; the tin-plate then introduced, perforated with a fine drill (see Plate, Fig. 2.) from the side, whilst in the bone, and secured by a deli-

cate pin ; this is to be repeated with all the joints, and a good imitation of the motion of the fingers is thus secured. The tin-plates of the thumb will require to be a little stronger than those of the fingers ; and the fact of its articulations with the trapazium, in such a manner as to be opposed to the other fingers, and on a different plain from them, of course attended to. A twisted wire, imitating the *anterior common ligament* running across the distal extremity of the metacarpal bones supporting the fingers, will make every thing here very secure.

69. The ulna remains to be articulated to the humerus, and the hand to the radius ; both joints are simply those of the hinge shape, admitting of flexion and extension. Tin plates of considerable strength should be used ; that for the elbow-joint will have its fixed extremity placed in the segmoid cavity of the ulna ; the rounded extremity made to play in a fissure cut in the centre of the pulley on the humerus. The radio-carpal articulation should be previously so far formed, as, before binding the carpal bones together in the manner we have described, a tin plate should be secured in the division between the scaphoid and navicular bones. This plate is to be firmly and immoveably fixed into the corresponding articular surfaces on the distal end of the radius.

70. The clavicle articulates with the sternum and acromion process of the scapula ; its connection with the acromion is best effected by means of a tin-plate secured with pins, whilst the sternal extremities of both clavicles should be secured by a strong copper-wire passed through the manubrium of the sternum, in the manner we have described for connecting the ribs, passing through the extremity of the clavicle, and out upon its inner and inferior surface, where a firm and neat eye should be formed. The clavicle is always a sound strong bone, and will not be apt to be torn up with this sort of connection.

71. The inferior or pelvic extremities bear a strong resemblance to the pectoral, and the various articulations

will of course be very similar. Two screws, of precisely the same form as those used for the scapulo-humeral articulation, are to be employed for the ileo-femoral; the central part of the acetabulum, though thin, is always firm sound bone, and the screw is to be passed quite through the bone, and secured by means of the nut on the inside of the pelvis.

72. The knee-joint is imitated most perfectly in the following manner. A slip of strong tin-plate, four inches long by about three-fourths of an inch broad, is to be doubled across its centre upon an iron wire, about the thickness of a crow quill; the extremities of the tin plate thus brought in close contact, are to be let into the posterior part of the proximal extremity of the tibia, and firmly secured by a pin passed from the posterior surface of the tibia. The loop will be placed transversely, and must project upwards, so that, when the condyles of the femur are *in situ*, it shall fill up pretty accurately the interspace between the two condyles of the femur. A drill is now passed through both condyles, in such a manner as to pass along the loop in the tin-plate. The patella is connected to the anterior tuberosity of the tibia by a ligament in the living subject, and the ligament should be simply imitated by a tin-plate in the articulated skeleton.

73. The ankle-joint is the most perfect hinge, and will be well imitated by the mode we have recommended for articulating the fingers; of course the fixed square end of the tin-plate will be connected with the tibia, whilst the round end will play in a slit made in the central part of the corresponding articular surface of the astragalus.

74. The phalanges of the toes are much more delicate than those of the fingers, and may be united together without much regard to motion, except, perhaps, between the metatarsal bones and the proximal phalanx, where the strength and size of the bones will admit of the use of pretty large tin-plates, so that a certain degree of flexion and extension may be imitated here. In other

respects, the articulation of the foot may either be precisely similar to that of the hand (section 67), or, from the remarkably flattened nature of the articular surfaces of all the tarsal bones, and diminutive size of the phalanges, the whole may very neatly, and with least injury to the bones themselves, be united together by means of pretty strong malleable iron-wire passed through the centre of each bone, and an eye twisted on the projecting extremity of the wire. A more delicate wire, twisted, and imitating in every respect the *inferior common ligament*, will bind the toes together.

74. The human skeleton cannot be made to stand on a pedestal, unless the pelvic extremities are converted into mere pillars; it is, therefore, most commonly suspended. The lower jaw may either be firmly fixed in its proper position, or made to be occasionally depressed by means of a strong piece of iron-wire, rolled into the form of a bell-spring, having one end firmly fixed into the basilar portion of the occipital bone, and the other supporting the lower jaw, by means of a firm wire passed from one angle of the jaw to the other. Upon the jaw being depressed, the cross wire will slide upon the extremity of the spiral one, and the spring of the latter will force up the jaw. A strong wire is next to be placed in the atlas, so as to imitate the *transverse* ligament, and the atlas itself fixed firmly to the condyles of the occipital bone. The flexion of the head will thus, of course, be rendered impossible, but the rotation of the head will be secured. The central wire connecting the vertebræ together, perforating and projecting beyond the odontoid process, will pass into the situation of that process, and quite through the cranium, so as to be brought out on the vertex; the wire having a screw fitted with a nut of any simple contrivance, for securely suspending the skeleton.

75. I have thus been minute in detailing the steps necessary for articulating the human skeleton, as, with

slight modification, the skeletons of all animals may be articulated upon similar principles. I would more especially have the anatomist always to prefer the *preservation* of the skeleton to any effect in articulation. If the articular surfaces are all destroyed, and the bones split up, by having heavy iron plates, &c., driven through them, the geologist finds it of no use to him in his researches after extinct species. Should the animal be young, the skeleton should always, if possible, be a natural one, as, by maceration, so many portions of bone, perhaps in a semi-cartilaginous state, are inevitably lost, as to render the preparation utterly useless. If the skeleton is a rare specimen, and comes into the anatomist's possession in an imperfect state, it must be preserved in its original mutilated condition; and no attempt made to supply the deficiency from the bones of another animal, however closely allied the species may be. Varieties, constituting important specific differences, may appear in themselves slight to the anatomist, but to the naturalist of the last importance. Cuvier determined the *true* Egyptian mummy from the spurious, by the form of the incisive teeth!

76. The four extremities of all quadrupeds should be articulated, so as to become merely pillars of support; and, if the animal is small, made to sustain the other part of the skeleton. Most large animals, however, such as the horse or cow, will require one or two central supports, to catch the spine anterior to the sternum and at the sacrum. As the head is generally appended to the extremity of a long neck, as in the horse, camel, &c., or is itself very heavy, as in the elephant, it will require a corresponding strength of iron rod passed, either as we have directed for the human spine, or simply along the canal for the medulla spinalis. If the iron rod is of considerable strength, it will require to be fashioned into the various curvatures which the spine of all animals naturally possesses, previous to introducing it into the spinal canal.

CHAPTER V.

77. On *natural* skeletons.—78, 79, 80, 81, 82. General remarks, instruments required, and mode of preparing fœtal and young skeletons.—83. On drying the skeleton.—84, 85. Skeleton of birds.—86, 87, 88, 89, 90. Skeletons of fishes, osseous fishes, cartilaginous fishes. — 91, 92. Reptiles. — 93. Skeletons of aquatic animals, care requisite in making, so that they may be useful.

77. By the term, Natural Skeleton, I mean the bones, or skeleton, of any animal preserved, connected together by their own proper ligaments. The preservation of these has generally, by British anatomists, been left to uneducated individuals, who, although sufficiently ingenious, being unacquainted with the nature and purposes of the preparation, have made things to look tolerably well, but which have led to no results, as giving little accurate information. On the continent of Europe, the most eminent in the profession prepare the fœtal skeletons generally with their own hands, and the results have been very striking. A great variety of ways have been followed in investigating the growth of the skeleton in the human subject, both by the comparative anatomist and physiologist; and, although I do not consider man as the type of animated nature, yet I admit that these investigations have, in the hands of continental surgeons, led to great and beautiful results, both to the practical surgeon, the naturalist, and the geologist.

78. Previous to the fourth week of the fœtal existence, the skeleton of the fœtus is almost entirely cartilaginous. After this period, however, daily changes take place, and the examination of the skeleton is extremely interesting and instructive. To make these skeletons, great care

in every step of the procedure is necessary, and a very considerable knowledge of anatomy is also essential. The instruments required are, a pair of good and delicate forceps, a scalpel short in the blade, and extremely sharp, and a pair of scissars, also short in the blades, with the joint perfectly easy. The fœtus should be fresh, at all events if the anatomist has not had much previous experience. The fœtus being placed on a perfectly clean board, the anatomist will make an incision along the mesial plane of the body, through the integuments merely, and he will proceed to remove entirely the integuments from the whole surface. The abdomen should then be opened, and the viscera removed. The muscles attached to the base of the lower jaw should then be carefully removed from that bone, and the tongue thus pulled towards the chest. The connection of the hyoid to the styloid processes of the temporal divided, and the gullet and trachea, with the bloodvessels, dissected off *en masse* from the anterior surface of the neck. The sterno-mastoideus, sterno-hyoid, and sterno-thyroid muscles, being carefully removed from their inferior attachments, the anatomist may cautiously remove the diaphragm from all its attachments, and, getting hold of the apex of the tongue with a delicate hook, bring the entire thoracic viscera through the inferior aperture of the thorax. These important viscera will thus be procured in a fit state for examination, and the thorax will be entire. The muscles must then be removed with the same care as if the anatomist was examining each. The forceps being in constant use, and the scalpel and scissars alternately, every portion, when detached, should be immediately deposited on a slip of paper, so that no debris shall remain about the subject. This process must be continued until the whole muscles are completely removed. The periosteum covering all the bones must on no account be touched. With this membrane present and entire, the skeleton will be found of considerable strength, so that the extremities of the long bones

may be reached, (injuring the ligaments as little as possible,) and by means of a *suitable* gimlet perforated. A wire must also be passed along the whole length of the spinal canal, and also into the interior of the cranium, so as to break down the central organs of the nervous system. The skeleton being now placed in pure water, the long bones and the cranium, including the spinal canal, is, by means of a small oyster syringe, to be most perfectly washed out. The preparation must then be placed in an ample dish full of pure water, which must be changed repeatedly whilst it continues to be tinged; and even a brush may, if used very delicately, be resorted to. A few drops of the aqua potassæ, or a little soda, may be added to the water.

79. The drying of this preparation must be conducted with care. If very small, it will, of course, when dry, be put into a glass jar, and should be placed extended on a board, using pins to keep it in a proper form, and prevent its contracting tendency, which is very great, in consequence of the parts in a cartilaginous state drying up almost to nothing. The ribs will require to be kept distended by means of portions of Bristol board, and the head should be filled with barley, or small dried peas, which will be easily shaken out when the preparation is dry. The preparation should be watched whilst drying, so that any error in the first adjustment may be corrected. No varnish should be used, but the skeleton, as soon as perfectly dry, put into a glass jar, and covered in with a single layer of well macerated ox-bladder.

80. The skeleton, prepared in this way, may also be preserved in turpentine, but this does not render the osseous part of the skeleton more distinct, and is much more troublesome to preserve. The skeleton, before being dried, may also be preserved in spirits of wine, by which means, the cartilaginous portions of the skeleton are prevented from being dried, but preserved of the natural size; and if, at any future period, the preservation of this

in spirits should prove troublesome, the skeleton may be dried. These preparations require so much care to prepare properly, that, although of considerable size, they should all be enclosed under glass, the expense of which is not at all to be put into the balance with the time and labour required to make them.

81. The human skeleton of a subject under twelve or fifteen years of age should be prepared in the above manner. Less care will, of course, be required in clearing the bones of the soft parts, and, perhaps, the periosteum may be partially removed, particularly from the head; but, if taken from off the bones of the extremities and trunk, the articular extremities (then generally in the state of epiphyses) will, the instant the periosteum is removed, separate, and an awkward artificial articulation becomes necessary. The whole skeleton, indeed, is so delicate, or, more properly speaking, so frail, as to crumble to pieces in a very short time. The size precludes the possibility of preserving them under glass; and the skeleton altogether is of little comparative utility, although the separate bones, particularly of the head, afford many interesting views of the growth of bone.

82. The skeleton of all animals under the size of the Shepherd's dog, or fox, will require to be made very much after the formula given in section 78, whether young or adult. Should the animal be adult, it may, of course, be safely allowed to macerate; but the trouble of articulating it artificially will be much greater, than the time necessary for making the natural skeleton by preserving the ligaments. If the animal is adult, the ligaments will be strong, and their attachment to the bones so secure, that maceration may be allowed to proceed very far before their destruction follows. I have always preferred, however, skeletonizing a subject when comparatively fresh. Should the animal be a rare specimen, the sooner it is prepared the better. The mode I have always adopted, of regularly dissecting the muscles, and dividing

their attachments, seems tedious at first; but the work is, in reality, sooner done ultimately, and much more efficiently. When the anatomist cuts through the muscles at random, and begins to scrape right and left, the progress may be compared to the dissector who, in dissecting a muscle, leaves the cellular envelope of the muscle for subsequent dissection. The progress, in fact, though apparently expeditious, becomes at last extremely tedious, troublesome and uninteresting; the bones are materially injured, in consequence of the scraping, and the ligaments which, in general, have their strongest attachments with the periosteum, get detached, in which case, the skeleton, when dried and put up, will never look well. The periosteum, if the animal is adult, must, of course, be removed, but with caution, as many of the ligaments, as we have just remarked, have an extensive attachment to this membrane. If stripped carelessly off the ribs, for instance, the cartilages of prolongation will separate from the rib, and no ingenuity in the after-articulation will give the thorax that symmetry which it possesses when the natural articulations are entire. A great proportion of animals are destitute of clavicles, and consequently the pectoral extremities have no articulation with the chest. These extremities will consequently be detached from the trunk in removing the muscles. The other parts of the skeleton should be carefully kept together, excepting the head, which should be separated so as to be cleaned with the greatest possible care. Should the anatomist have opportunity, i. e. the command of a steady artificial heat of about 80°, the head of most adult animals may be macerated and affixed to the skeleton when dry, in the manner described in section 83. When the muscles are completely removed, and the periosteum stripped off in such a manner as to preserve the ligaments, the various articular surfaces of the bones composing the extremities will be so exposed as to admit of each extremity of the bones being perforated, without in-

juring the ligaments, and a wire, as large as can be conveniently introduced, passed completely through. This perforation had better be made by means of a small useful drill,* thereby avoiding the risk of splitting up the bones, or the chance of the gimlet starting off the extremity of the bone, and passing through the hand or finger of the anatomist; besides, it is of importance to have a large orifice, and the drill will effect this with the greatest safety, both to the skeleton and the operator. Water is now to be injected into the interior of these bones, and the wire passed repeatedly through them until the medulla is completely washed out, and the bone becomes semitransparent. This must be done with all the long bones, otherwise upon being dried, they in general contain so much oil as to become nearly black and extremely filthy, and it will be recollected that the omission will not be easily remedied afterwards. The skeleton thus far prepared, must be put amongst an abundance of water, and, whilst the water is allowed to flow over it, well brushed, unless particularly small and delicate. The skeleton of a mouse, for instance, will not stand brushing, but still the long bones of even the mouse must be bored, and washed out by means of a syringe—the water injected may be warm. The skeleton should then be allowed to remain amongst water, changed daily, as long as the slightest tinge appears; and, lastly, put amongst an exceedingly dilute solution of the aqua potassæ. Ten or twelve drops of tbe aqua potassæ of the shops will be sufficient for the smaller skeletons, where its bleaching effect is alone wanted; whilst, if any oil is to be got rid of,

* Fig. 2 represents the form of a drill stock which I had made for me, and which I have found so useful, as to be constantly in use when any articulation is in hand. The screw enables me to fix it wherever I may be working, and the branches arising from the screw being of sufficient strength, enables me to hold it in my hand, so that I can reach any part, however situated, with my drill.

and the skeleton the size of a cat, a drachm may be added to the water. The anatomist will discover by inspection, when the oil and colouring matter have been completely extracted; when, if not, the solution must be *renewed*. The practice of adding to the old solution is an extremely dangerous proceeding.

83. The anatomist should now proceed to dry the skeleton, and considerable taste and ingenuity may be displayed in this part of the process. The skeleton should be stretched out on its side, and the extremities put as nearly as possible into the position proposed to be given to the preparation. With a foot-rule the requisite size of a pedestal is ascertained, which should not greatly exceed the extent of surface covered by the extremities when the skeleton is set up. The pedestal should be made of soft wood, stained black, or painted according to the taste of the anatomist, and by means of the foot-rule, the precise position each extremity will occupy when set up ascertained. Malleable wires suited to the size of the opening made in the distal extremity of the tibia and radius, when washing out the interior of these bones, should then be firmly fixed into the pedestal: these wires should not be longer than to pass about half way up the respective bones. The exact height which it is proposed to give that part of the vertebral column, immediately anterior to the sternum should be ascertained; to this add the length of the cervical region, and allowing a sufficient portion for passing into the interior of the cranium, a portion of brass wire or fine malleable iron wire, of sufficient strength to support the head, must be fixed firmly in the board, exactly in the mesial line of the pedestal, and a little anterior to the two wires prepared for passing up the radii of the pectoral extremities. A hole must now be drilled through the body of the last cervical vertebra, slanting the drill towards the head, and managing so that the point of the drill shall pass into the vertebral canal. The central brass wire being bent to the

height and form proposed to be given to the head and neck, is to be passed through the opening made in the seventh cervical vertebra, and along the spinal canal until that portion for the support of the head projects beyond the atlas. The four extremities may then be fixed by passing the four wires previously fixed in the pedestal up the respective extremities, and bent at such angles as to give the natural appearance to the limbs. A portion of the frame described, plate Fig. 1,* will then enable the anatomist to give the spine its natural curvature, and when dry, the skeleton will possess an unusual degree of firmness. A single twist of wire passed across the base of the cranium, through any of the foramina in the base, will fix the head on the central wire projecting beyond the atlas, so that this most important part of the skeleton can be at any time removed and examined, and again replaced without injury or much trouble. Should the skeleton be small and delicate, the *central wire* will be found sufficient, and the limbs may be fixed to the board, after the skeleton is dried, by small portions of pins. The central wire I prefer to every other mode of support. Every one in the habit of visiting museums, must have been struck with the very frail appearance most delicate skeletons present, which have been up for any length of time. This is generally in consequence of the head wanting support. Now, my central wire secures this, and the skeleton retains its position for years. It has also the advantage of being so concealed, as not to be perceived by any but the curious. Should the skeleton be that of a very small

* The frame consists of any number of thin lathes of hard wood, each about twenty inches in length, one inch broad, and two-eighths in thickness, sunk into a pedestal composed of lead, weighing one lb. These lathes are all perforated with holes at equal distances. A number of delicate rods made to fit the holes, enables the anatomist to support any part at what height he pleases, as seen in the plate. The portable nature and small cost of this frame are special recommendations, and I have found it answer every purpose.

animal, or by any oversight become extremely frail, it should be simply dried on a piece of Bristol board, or suspended as it were by means of delicate wires, and secured in a glass jar. Should maceration have destroyed *all* the ligaments, still the bones are not to be thrown away, but should be arranged and stuck by means of gum in solution, on coloured Bristol board, and secured in a glass jar. This, indeed, is a troublesome preparation to make, but of great value, as by this mode we have it in our power to examine all the articular surfaces.

84. The skeletons of birds require nearly, without exception, to be natural skeletons. They are bipides, and have a wretched look when supported by means of wire, or other artificial invention from the pedestal. The process of preparing the skeleton is precisely that followed with regard to quadrupeds. Although it is a fact that many of the bones contain air instead of medulla, yet it is a good general rule to drill and wash out all the long bones until they appear transparent. The ligaments are, perhaps, more delicate than those of the quadrupeds, and require corresponding care in their preservation. The form of the pedestal should correspond with the nature of the bird, as the perchers, for instance, should be raised, whilst the waders should stand on a flat surface. The entire skeleton of most birds are, it must be admitted, is very light, yet the long neck, with the head appended to its extremity, renders an artificial support necessary, however well preserved the ligaments may be. Two malleable wires, as strong as the interior of the tibia will admit of, and of sufficient length to pass about half way up that bone, must be fixed in the pedestal, and bent at the proper angles, corresponding to the succession of broken levers which the tarsal and tibial regions of birds always present. The skeleton may, with the greatest possible advantage, be allowed to be nearly half dry, when the ligaments will be found to have acquired

such a degree of firmness as to retain any position given to the bones. The wings should then be secured to the sides of the thorax as in a state of rest, by means of fine brass or malleable iron wire twisted around them, and any of the nearest ribs which may seem most suitable. A wire, the length of the spinal column, of sufficient strength to support the head, must then be passed along the canal previously occupied by the medulla spinalis, and projecting so far into the head as to catch some portion in the interior, and thus support and fix it.* The whole skeleton thus prepared, is now to be placed on the pedestal, and the two wires previously fixed in the pedestal, passed up the centre of the tibia behind the tarsal bones, which are generally concave posteriorly, and thus, in a great measure, conceal these wires. The head and trunk should, during this part of the process, be supported by the frame, plate Fig. 1, and should the ligaments be sound and fresh, all that will be necessary is to twist two turns of delicate wire round the femur on each side, at the same time including the rib most suitably placed, when the eye of the anatomist tells him that the bird seems to stand on its legs. The skeleton should now be left to dry, simply but *fully* supported by the frame, as seen in plate Fig. 1, and will, in general, be found extremely firm and in a natural position. Should, however, the body threaten to fall forward, two portions of wire passed into the upper part of the tibia, right and left, and bent so as to catch the spine, will effectually prevent this tendency. The anatomist will, at first, be most apt to commit error with regard to the strength of wire required to form these supports, but a single trial or two will give knowledge in this respect.

85. The skeletons of birds of the size of a goose can be articulated artificially; but it will be found a trouble-

* A portion of pretty strong but malleable wire should be introduced into the extremity of the femur and head of the tibia on each side, so as to permanently fix this joint.

some process, and, unless that of some extremely rare specimen, by no means commensurate to the trouble.

86. The skeletons of fishes require great care in making, and considerable modification, according to the sort of fish. The skeleton is found in different degrees of hardness, divisible, however, into the following three, viz. osseous, semi-osseous, and cartilaginous. Previous to the year 1824 there certainly did not exist any skeleton of a fish fit to be seen in any museum in Edinburgh. In the very splendid collection formed by the late Dr Barclay, great efforts had evidently been made to excel in this department of comparative anatomy, but the Doctor had failed in procuring even a tolerable skeleton. The skeleton of a perch still preserved in the museum now the property of the College of Surgeons, appears to have been considered a sort of *ne plus ultra*, as it has been drawn, engraved by Mr Mitchell, and published in a work on the skeleton by Dr Barclay. The engraving is a good picture, and certainly a striking representation of the original, but the skeleton itself is not much unlike some of the far-famed Aberdeen haddocks, and would therefore afford a very tolerable breakfast ere it could be dignified with the appellation of a skeleton. A haddock, I recollect, was the first skeleton I attempted, and I remember Professor Jameson did me the honour to give this a place in his museum. A sort of rage for this kind of preparation then got up, and some tolerable specimens were produced. It is admitted by all, that they are the most troublesome preparations to make, *if properly made ;* for certainly nothing can be easier than to make such as we generally see. I have many peculiar views with regard to what the comparative anatomist should consider truly the *skeleton*, if it is proposed to draw any analogies between fishes and quadrupeds. The skeleton, according to my view, would be very easily made, inasmuch as I would remove all the fins with the integuments, as belonging to the tegumentary system. I admit, however, that the preservation

of the fins adds greatly to the beauty of the preparation, and as their preservation constitutes the principal difficulty in cleaning and preserving the skeleton, I have hitherto invariably kept them attached to the true skeleton, and shall now proceed to detail the necessary steps to be pursued with an osseous fish, say the haddock. The specimen being, in the strictest sense of the word, *caller*, the integuments are to be systematically stripped off, leaving that thin epidermic covering which invests the fins; a longitudinal mesial incision of the abdominal surface, through the soft parietes, will enable the anatomist to remove the viscera. The pelvic bones, whether near the anus or under the throat, are next to be removed, together with the fins they support. The pectoral extremities should next be detached from the temporal bone, to which they are generally articulated, and removed from the parietes of the body which they encircle, detaching them successively from the gills and body of the hyoid apparatus, bringing along with them the single and often very small azygous bone, or sternum, lying between them and the centre of the body of the hyoid, and particularly two bones lying close upon the ribs, which are, however, connected by ligaments to the bones of the shoulder, and are analogous to the acromial sternum of birds. The hyoid apparatus must then be removed from its attachment to the base of the lower jaw, and the styloid processes of the temporal; and lastly, the cranium itself, which, although it could now easily be cleaned in connection with the trunk, could not be dried so conveniently as when detached. The various sections thus made, may now be put amongst pure water, not with the view of macerating, but rather for the purpose of keeping them fresh, and in order to get rid of colour. The spine and its appendages must be immediately cleaned, as a single day will destroy the ligaments connecting the ribs to the transverse processes, and it will be scarcely possible to unite them artificially. The muscles will be found to run in longitudinal layers along the spine, and observing this

fact, may be removed in large masses with the ivory handle of a scalpel; each rib must, however, be carefully cleaned with delicate scissars and forceps. Most of the ribs have additional process projecting backwards and upwards from them, which must also be carefully attended to. The spinous processes, abdominal and dorsal, and the inter-spinal bones supporting the fins, have all, in addition to the attachment towards the central spinal column, an inter-osseous membrane dividing in a very complete manner the muscles, &c. of the right from those of the left side, and which membrane must not be touched until all the muscles are cut away. With a pair of *good* forceps the thin cuticular covering of the fins will now be removed in a sheet, and a tooth brush, with the assistance of a little warm water, will sweep off the dark pigment-looking covering which will still obscure the individual rays of the fins; a wire will now be passed repeatedly down the spinal canal, and also down the canal at the root of the abdominal spines, along which the continuation of the aorta passes towards the tail. The preparation may now be brushed cautiously, and allowed to remain in abundance of fresh water for a day or two.

87. The parts next requiring immediate attention are the pectoral extremities. These should, if possible, be cleaned, whilst still connected at their sternal extremity. The hyoid apparatus will only require the gills, (that vascular fringe supported on the external margin of the branchial arches,) to be cut off close to the arches, but on no account should the membrane covering these arches be removed, as the whole complex collection of bones will in that case separate. The membrana branchiostegi may then be dissected off cautiously, as the rays supporting this membrane are generally very slightly connected to the body of the hyoid bones. The pelvic bones may then be cleaned in a few seconds, and the head is now the only portion remaining. The eyes being removed, the periosteum of the bones should be laid hold of with the forceps and stripped off. The principal muscles requiring to be removed are the

temporal and masseter, in the removal of which the only bones which will be in danger are the small chain of bones forming externally the floor of the orbits. It will be found difficult to clean these small chains of malar bones in situ, and it is as well at once to remove them; they will be found to be doubled on themselves as it were, and can be very conveniently strung on a delicate portion of wire to be attached when the head is cleaned and dried. This, therefore, had better be at once done, and each put into a secure place until wanted. The head may then be perfectly cleaned, all the bones, although many of them apparently loose, will be found connected together with pretty strong and distinct ligaments. The brain being carefully washed out, and the skeleton allowed to remain an hour or two under a gentle current of pure water, may be dried nearly in the order in which each portion was cleaned. Having allowed the various sections to get partially dry, the spine and appendages will be placed on a flat and perfectly clean board, and each ray of the fins must have its pin. The spinal column also fixed with pins; the ribs likewise properly arranged and retained with pins; and should the proper time be given for the ligaments to get a certain degree of consistence in consequence of beginning to dry, the slightest support will keep the various parts in a proper position. The pelvic and thoracic extremities must next be spread out on the board, and the fins secured with pins in the same manner as those of the spine. The hyoid apparatus, including the hyoid bones, branchial arches, radii-branchiostegi, will form a distinct division of the skeleton, and the branchial arches will have, as we have directed, the inner surface covered with the membrane originally lining them. This membrane will be found to form the inner surface of the pharynx, and the two bones called pharyngeal will thus remain connected together, the whole forming a kind of circle; this should be distended with portions of Bristol board, so as to give at once a correct transverse measure in drying the extensively moveable gill covers, and enabling the ana-

tomist to replace the whole in finishing the skeleton with perfect ease and accuracy. The head should now be firmly suspended by means of the frame, plate, fig. 1, and the jaws, gill covers, &c. fixed so as to display as much of their surface as possible. The various portions being allowed to become perfectly dry, may be handled with safety. The hyoid apparatus, then the pectoral extremities, replaced, and the head thus furnished, connected with the spine by means of a slender portion of stick, cut so as to fill up accurately the foramen magnum, and pass for a short way down the spinal canal. The articulations required are extremely few, and must be done with very soft fine iron-wire. The portions of bone to be united must each have a small hole drilled in them, in such a manner as the wire when passed into them shall pass directly through both, with a pair of light rounded twisting plyers; the ends of the wire are then to be rolled round separately until the bones are brought in close apposition, and the articulation feels firm. This mode is much preferable to twisting the two ends of the wire together, as most of the fish's bones will be torn up by this process, and the articulation be insecure.

38. The bones of the cod, haddock, and all fishes called *white fish*, require no maceration, but will dry perfectly white and free from oil, but like every thing else intended for preservation, must be kept entirely free from dust during the preparation of the skeleton. The salmon, trout, and all its *co-genera*, can by no process be made white. Their bones are naturally of a yellow colour, and, if the fish is in prime condition, the skeleton will be oily. If made after spawning, however, the skeleton will exhibit little trace of oil, but will still be yellow; and when any individual, of whatever standing he may be as an anatomist, complains of the yellow colour of your skeleton of the salmon, &c. he may be informed, without the least ceremony, that he knows nothing of the comparative anatomy of the salmon.

39. The Lophius piscatorius is an example of a semi-

osseous fish. The skeleton is soft, but dries well and white, requiring merely a little more care in cleaning than is necessary in the cod or haddock.

90. The cartilaginous fishes, as the skate, have an exceedingly complex skeleton, and therefore require still greater care in skeletonizing. The cranial cavity must be stuffed with tow whilst drying, and a malleable iron-wire (simply drawn through an oiled cloth) passed along the spinal canal, at once to keep the spine of a natural length and shape, and to prevent the walls of the canal from closing in upon each other. Alcohol has a powerful effect upon the flesh of fishes; and I have succeeded in making the most perfect specimens of fishes which have been immersed *for a length of time* in strong spirits: of course the fishes were of small size. With a pair of common dissecting forceps in each hand, the flesh may be picked off, leaving the bones connected by their natural ligaments uninjured.

91. To prepare the skeleton of most reptiles, the same mode must be followed as that directed with fishes. The skeletons of serpents are extremely tedious to make, and as no instructions, so far as I am aware of, are given in any work, perhaps no skeleton troubled me more at first. Unless of a very large size, they must be made altogether as a natural skeleton, as it will be found impossible to articulate the bones artificially. When any of the ribs get separated, they generally must just be attached by means of gum in solution; but the separated parts must not be very numerous, if the skeleton is ultimately to look well. But the principal difficulty I experienced was in drying the skeleton, after having been cleaned. A common adder has upwards of 200 ribs on each side, and I, in my ignorance, gave each rib a pin to make it dry in position, but all would not do. The skeleton did not please me. After repeated attempts, and much waste of ingenuity in the invention of frames, cradles, &c., I discovered that all that was necessary was to allow the skeleton to lie on a clean cloth until the moisture had,

in a great measure, evaporated, and the ligaments were in such a state as to admit of being twisted in any way, but to remain in the position into which they were put, and even to sustain a light weight. The skeleton of the rattlesnake, now in the Museum of the College of Surgeons (Knox's Catalogue, No. 190.) was the result. It dried in the form in which it is placed, nearly without the aid of supports. The frames and cradles, which cost me some pounds sterling, have never since paid the interest of the original outlay.

92. In all reptiles, as the tortoise and turtle, the skeleton, properly so called, and the integuments, both contribute to form the hard parts, in the manner in which I conceive what has been called the skeleton of fishes is formed. The anatomist can certainly preserve all the hard parts, and call it skeleton if he chuses; but in investigations into comparative anatomy, and in drawing analogies, the distinction must be carefully attended to, between what is strictly analogous to the skeleton as seen in man, where, excepting perhaps the teeth and nails and hair, we have no hard products connected with the integumentary protecting parts.

93. In all aquatic animals, whether mammiferous or not, the state of the skeleton requires particular attention, as it would appear that those portions of the skeletons called epiphyses in man either do not ossify at all, or, if they do ossify, they do not unite to the other parts of the skeleton. Thus, although the greatest care had been taken, and no expense spared, by Cuvier, to procure perfect skeletons of cetaceous animals, I have merely to refer to his great work to shew that he had *not* succeeded in procuring a perfect skeleton of any one of them. In the autumn of 1831, I purchased the carcass of a whale, of gigantic dimensions, almost for the special purpose of procuring the skeleton, and I deemed it necessary to superintend not only the dissection, but every manipulation necessary for cleaning the skeleton. The sternum was of so singular a shape, and placed in so peculiar a

manner, that, notwithstanding the unwieldy nature of the two ribs with which it was connected, I preserved this sternum and ribs as a *natural* skeleton, i. e. connected with its own proper ligaments. There is, I do not hesitate to say, not an anatomist in Europe who would have placed the sternum in its natural situation, if it had been allowed to separate without its situation being particularly noted. The epiphysis found on the spinal margin of the scapula in man and all animals, assuming so interesting a character in the crocodile, &c., was of vast size in the whale, but in a cartilaginous state, requiring the greatest care and infinite trouble to preserve, still, however, in my opinion, forming an essential part of the skeleton. The pectoral extremities also, although each weighing nearly a ton, were brought to Edinburgh, with all the soft parts on them, so as to secure their perfect preservation, by being deliberately dissected and prepared as a *natural* skeleton. The skeleton required upwards of three years almost constant attention before it was in a fit state for setting up, the head constituting the principal difficulty and delay. The sections I made of the head, so as to render it portable, were directed with a view to the anatomy of the interior of the cranium and nostrils, and were thus rendered more useful to the anatomist than the bones separated at their natural sutures, had this been practicable. A specimen of the Rorqual of Fabricius, (B. rostrata, Hunter; R. minimus, Knox,) came ashore at Queensferry some time ago; and, although this animal must have weighed nearly a ton, and was eleven feet in length, yet I perceived that the skeleton would require to be preserved as a natural skeleton. It is now evident, from an examination of this magnificent specimen, that any other mode of preservation would have led to its total destruction. Notwithstanding its great size, each vertebra would have separated in the progress of maceration into six or eight different portions; and even supposing a person with sufficient know-

ledge and possessed of inexhaustible patience could have been procured to articulate the skeleton artificially, yet the *cartilaginous* epiphyses would have been lost, and could not have been supplied artificially. The baleen also was removed from the surface of the palate, connected with the soft parts which had produced and nourished it, dried in this state, and then replaced with the greatest care in the mouth; whereas had the plates of baleen been allowed to separate, no ingenuity or industry could have replaced them in situ. Thus the skeletons of whales in Paris have never, so far as I can discover, given any one who has seen them the slightest idea of the real appearance of the baleen. The coracoid process of the scapula in the whale is merely tipped with cartilage, which might easily escape observation, and yet this little portion of cartilage we know to be the elements of a clavicle, if Nature had found that the whale required a clavicle. Again, many of the vertebræ in the Rorqual Giganteus weighed upwards of seventy pounds, whilst those terminating the spinal column posteriorly did not weigh many ounces; and indeed eight of the last vertebræ were prepared by me as a natural skeleton, and, in consequence of the enormous quantity of soft parts which required to be cut away, took me not less than a week to clean.

PART II.

ON THE MODES OF PRESERVING DISEASED STRUCTURE ILLUSTRATIVE OF PATHOLOGY.

CHAPTER I.

94. Having, during the comparatively short time I have been connected with the profession, witnessed the *opening* of the anatomical museum in the College of Edinburgh to medical students, and which did not take place until the collection belonging to the Royal College of Surgeons, then under the care of Dr Knox and myself, had been open for more than twelve months to the surgical students—and considering this as forming quite an epoch in the medical and surgical school of Edinburgh, I feel particularly anxious that the student should derive all the advantage which the command of museums, where ever situated, are calculated to afford. *I have already remarked that museums will generally take their character, as it were, from the favourite pursuits and nature of the*

studies of the person who forms them, and a short conversation with the conservator, added to a history of the progressive rise of the museum, will often enable the surgeon to anticipate, in a great degree, the extent of pleasure which may await him on a visit to the collection. Where the collection is very extensive, a single individual cannot, of course, do every thing that may be required in its increase and preservation. Assistance must be had recourse to, and thus many highly objectionable practices and numerous mistakes will creep in. If you employ a *non*-professional person, for instance, to articulate a skeleton for you, his sole object will be to make it *look well:* he will unhesitatingly proceed to substitute the bones of other animals, when those of the skeleton which he may be putting up may happen to be unsound, or destroyed by using too great liberties with it in articulating. The non-professional, I find, are exceedingly anxious to have every thing *complete* about a skeleton, and they carry this so far as to supply with a formidable set of teeth jaws which *never* carried teeth of any kind. They will even put in a piece of wood, rather than allow any deficiency to appear. What is worse than all this, they attempt to *improve* nature, and do not hesitate to introduce an entire phalanx, or even a new toe, into the foot of an animal, merely because the foot seems *to them* ill formed. The skeleton of the ostrich, which Cuvier has represented in one of his works, must have been the handiwork of some such mechanist. It is a fact, that instances have occurred, where, because the cervical vertebræ of a bird proved troublesome on account of their number, three or four of them were unhesitatingly thrown away by the person employed to put up the specimen, and the skeletons declared to be greatly improved, in consequence of the shortened neck. I have been much astonished lately, to find that nearly the whole engravings in Cuvier's work on the Fossil Remains must have been taken from imperfect specimens, and, what I confess I

do not perfectly understand, *no* notice is taken of these deficiencies in the letter-press. The skeleton of the dugon, for instance, wants the *sternum*, many of the vertebræ, and the temporal bone, and not a word of all this is to be found in the letter-press. The skeleton of the Balæna Australis in Paris, I am informed, has indeed baleen in the mouth, but I have been also assured that it is *not* the baleen which the animal made use of whilst alive. I admit that it may have been found difficult to preserve the baleen, and I also admit that its presence is a great ornament to the skeleton; but the substituting a part of one animal, to supply the place of a lost portion in another, is a procedure which can never be allowed. It is not admissible even when positively stated in the description or catalogue, for by-and-by the fact gets lost sight of by the herd of copyists who follow, and the public are misled and imposed upon. But although these practices are deeply to be deplored even in healthy and comparative anatomy, when the system is carried into diseased structure it becomes a much more serious matter.

95. A most singular instance of the want of pathological knowledge exists in a museum I lately visited, where, in preparing the skeleton of a rickety person (the lower jaw-bone of which had been affected with an interesting and rare morbid condition, leading to the absorption of the alveoli,) I observed the mouth had been supplied with a very complete set of teeth, and the diseased state of the alveoli very dexterously repaired with putty! This was evidently the direct consequence of want of pathological knowledge. It had been supposed by the persons who may have repaired the skeleton, or even he who originally put it up, that the appearances presented by the alveoli were the results of protracted maceration; but they should have known that the lower jaw at least is of so dense a texture when sound, as to resist the decomposing effect of delayed maceration longer than any other bone in the body; and as the bodies of the verte-

bræ were evidently sound, the lower jaw must have been in a diseased state previous to the death of the individual. As another instance of the misfortunes attending a want of proper knowledge, I recollect of seeing a preparation libelled "Case of fracture of the acromion process of the scapula," which, when examined, proved to be simply the acromion process remaining as a separate portion of bone up to the adult period of life. Now, if the individual had ever prepared the young skeleton sect. 78, or heard a proper course of lectures on the osseous system, the mistake never could have been committed, for he would immediately have perceived, that instead of a fracture, it was merely a case where the young condition of the scapula was persistent. It might have informed him of more, for in all probability the whole skeleton of the individual presented a similar appearance. I have been informed that some teachers actually proceed with a hammer to fracture the bones of the cranium, and bring them forward as subjects of lecture. I cannot conceive a greater error than to suppose that the injury inflicted on a dry bone would ever bear the slightest resemblance to the effects of an injury sustained during life.

96. Diseased bones are (with an exception or two which shall be afterwards mentioned,) either to be preserved in spirits of wine or to be prepared by maceration. If the morbid parts come into the hands of the anatomist during the progress of the disease, as in cases of caries, necrosis, osteo-sarcoma, &c., an examination should of course be made of them, in reference to the state of the soft parts, so that the morbid structure may be preserved as a soft preparation; should the bones *only* be deemed worthy of preservation, then maceration must be had recourse to. As the unfortunate patients subject to such diseases are generally extremely emaciated, there is less risk of adipocere being deposited in the progress of maceration; but we cannot too strongly urge upon the

anatomist the fact, that the more expeditiously the process of maceration is completed, the better in all cases. With diseased bones, however, it will be recollected that the destruction of the soft parts must be *complete* before the bone is removed from the macerating dish, so that if looked at prematurely, and found not cleaned, the preparation must just be returned to the *same water*, and, if possible, brought into a warmer temperature. When all the soft parts are evidently reduced to a pulp, a gentle stream of pure water must be allowed to play over the preparation until every thing is washed away. The preparation is then to be put in a weak solution of the aqua potassæ for a day or two, and finally dried. It is essential to put every thing of this kind immediately into a glass-jar, as dust (which every where abounds) completely destroys them, and it will be found that they can be *touched* by few, perhaps only with safety by the person who has prepared them. Should the preparation be denuded to a great extent of soft parts, gradual and steady artificial heat will be found essential to promote maceration; and indeed caries of the spine, if a recent affection, should always be carefully dissected, and preserved dry or in spirits of wine. The vertebræ, when allowed to lie for months in water, assume an appearance so like caries that I have seen an excellent pathologist mistake such for a morbid state of the bone. In scrofulous caries of the bones, portions of the osseous texture often die, and being loose, are in danger of floating away with the water whilst washing the preparation. The greatest care is therefore necessary in the whole process of preserving diseased bones, for if this dead portion were lost, the pathologist would find it difficult to account for the continued constitutional disturbance which may have necessitated an operation, or even caused the death of the person. I repeat that this small loose dead portion, which I have stated to be so readily lost in finally washing the

specimen, actually constitutes the sum and substance of the morbid state of the bone.

97. The bones in a case of *mollities ossium*, if recent, must be cleaned according to the directions given for preparing the natural skeleton. They will not macerate, but would get destroyed just as fast as the muscles, unless, indeed, the disease has long ceased, and the skeleton, though dreadfully deformed, will then be found harder than usual.

98. Much depends on judiciously planning the examination and ultimate preparation of a diseased bone. Whilst in charge of the Museum of the Royal College of Surgeons, Edinburgh, the preparation xx. C. 414. (a diseased tibia,) was sent me, and whilst much was said of the manner in which it should be prepared, I had made the section, having determined to see the interior of the enormously enlarged tibia, preserving one-half in alcohol, and macerating the other. Although I thus acted contrary to the opinion of many gentlemen whom I desired of all things to please, yet I was quite certain that my experience entitled me to a preference in the mode of preparation, and I know I could calculate on the unbiassed approbation of the munificent donor. It happened, however, that I received the approbation of all persons.

99. The following pathological conditions of bones are generally preserved as *dry* preparations (sections 39 & 96.)

A. Fracture, if united, and of old standing.
Rickets.
Wasting of bone.
Inflammation (if the effects are extensive).
Abscess.
Caries.
Necrosis, if of long standing.
Interstitial absorption.
Interstitial deposition.
Exostosis.

Spina ventosa.
Osteo-sarcoma.
Ivory change.
Skeleton in cases of hydrocephalus.

B. *Diseased conditions of bone preserved as wet preparations,* (sections 7, 8, &c.)
Fractures, if recent.
Inflammation, if recent. The preparation should also be injected, (section 19).
Necrosis, if recent—inject, (section 19).
Medullary sarcoma.
Cancer.
Fungus hœmatodes.
Mollities ossium, or as a natural skeleton.
Appearance of bones after amputation.

100. The pathology of the teeth is either not well understood, or, so far as my reading extends, has not been fully laid before the profession. Dental surgery, in fact, forms an extensive branch of itself; but I have always been of opinion that this is too exclusive, and that all surgeons should know *something,* at least, of the teeth. I have fully satisfied myself from recent investigation that the enamel, *when present,* is the only part of the tooth which can be called *inorganic.* The ivory part of the tooth is nothing more or less than very hard bone, and remains under the same influences of nutrition and absorption as the other parts of the skeleton. I can therefore perfectly understand the nature of caries of the teeth, &c. I have stated that I am of opinion that the public should be put right with regard to the erroneous belief that no one knows any thing about the teeth but the dentist, and I shall relate the following case in point.—A young woman, aged 15, applied to me for an affection of the teeth, occupying the right side of both the upper and lower jaw. The patient stated that she had suffered severely from toothach for a length of time, and that the teeth on the right side appeared all diseased. Her cheek was a good

deal swollen, and her general health evidently not very good. I looked into the mouth, and found the mucous membrane present a remarkable white cartilaginous appearance; small portions only of the teeth were seen projecting beyond the gum, and these portions of teeth were of a deep yellow colour. I found I could remove large portions with my fingers, and I inquired if the patient had ever used any means for the cure of her toothach. She said that she had repeatedly applied a fluid by means of a piece of linen rag, and not being able to fix on any particular tooth, had applied it generally to the whole series on that side of the mouth. The patient had none of the fluid left, but stated that she had purchased it at a dear rate from an apothecary shop: That it destroyed any part of her clothes, and even the skin when falling on them by accident; and that when put into her mouth, it produced a hissing noice similar to a heated iron when plunged into water: That it at first relieved her of pain, by rendering the entire side of her mouth void of all sensation, but finding it so troublesome to use, she had given it up for some time. My remarks on this case are as follows:—The patient had laboured under a neuralgic affection of those branches of the 5th pair of nerves which go to the teeth. The teeth had evidently been free from blemish, and I think those which were sound, were the best I ever saw. The remedy sold her had been some powerful acid; the enamel was evidently entirely destroyed, and as the ivory part must, at the patient's age, be in an active state, the result may in all probability be some frightful tumour.

101. The anatomist, in preparing the teeth for his museum, will find a good saw make its way through all kinds of teeth—even that of the elephant's grinder, which, however, is certainly the hardest of all hard substances. The enamel is a glandular secretion; and after the section, by means of a saw, presents rather a chipped appearance; a little rot-stone, water, and a marble slab, polishes the

cut surface to most perfection for seeing the textures. The saw with which the section should be made ought to be a *heavy* sash saw, and little or no force should be used, but the saw allowed to cut its way through, more after the manner of a file than a saw. In making sections of teeth of a small size, it is best at once to sacrifice a part, and remove it by means of a file. Nothing can be more beautiful than a cabinet illustrative of the growth, diseases, and comparative anatomy or physiology of the teeth. Complete sets, for instance, of the milk, or temporary, and the permanent teeth, should be in every one's possession who proposes to extract diseased teeth from the living subject. The jaws of a child often contain both sets in a very advanced state; and the whole are displayed, by simply rasping off the outer tables of the upper and lower jaws. The surgeon should be able at once to name any particular tooth when presented to him, and this he can readily do, by familiarizing himself with the appearance of the fangs and corona. A knowledge of the position of the fangs can alone enable the surgeon to extract a tooth with ease and safety to his patient. Many persons, from a supposition that the teeth are foreign bodies, and implanted in the jaws after the manner of a nail in a board, use the most unjustifiable liberties in scarifying the teeth, not only of children, but adults. The gums of a child should *not* be touched unless the symptoms are urgent, and, if possible, the offending tooth *alone* interfered with. If a tooth is cut down upon prematurely, the whole subsequent process of its growth, and particularly the enamel, must be interfered with; and, in all probability, the tooth will ultimately come to be extracted.

102. The treatment of dislocations and diseased joints is still in the hands of the empirick. When we reflect on the great delicacy of all synovial membranes, we may almost certainly conclude, that after dislocation a perfectly sound state is never restored, and few or

no good cases of dissection are on record. Diseases of synovial membranes are admitted by all surgeons to be most important, from their extreme danger to the patient. Little is *certainly* known of their pathology; and, until more is known, their treatment must want precision. Dissection alone can furnish the necessary knowledge; and I therefore suggest, that all affections of joints, when they come into the hands of the anatomist, should, if possible, be injected, dissected, and examined with the greatest care, and the morbid appearances presented on dissection carefully noted. Unfortunately, when amputation has been performed, a rude cut is generally made into the joint, and the cartilages being declared *diseased*, —the bones bare,—the operation is justified, and we seldom hear more of the joint. In fact, the unfortunate cut renders it impossible to make a proper subsequent dissection, even if the surgeon should be competent for the task. Thus, in most museums I have visited, the joint answers simply as a record of some fortunate, or unfortunate case, the alcohol having rendered every texture of pretty nearly one uniform appearance. This is not the fault of the alcohol, but that of the anatomist who has failed to examine in proper time, and mark out with bristles the affected part. Thus, the most striking preparations commonly seen in museums are those of the osseous texture after maceration. Now, although the bones do often exhibit remarkable changes, yet all these are only *effects*. The cause of the diseased bone, the loss of limb, and often life, has been, in reality, for ever destroyed by the process taken to preserve the preparation, viz. maceration.* It appears to me that the principal object to be kept in

* The advantages following attention to the preceding remarks, are well illustrated by the examination of a preparation in the M. R. C. of S. E. XXI. A. (a case of false hip-joint). The part wished to be shewn by the dissector has been marked out with a black bristle, and the preparation thus rendered at once beautiful and perfect.

view by the anatomist in his researches after the true pathology of affections of the joints, is to ascertain in what *texture* the disease has commenced, and a few carefully recorded cases, followed by equally judiciously conducted dissections, will no doubt lead to a correct line of treatment in these at present fatal affections. I lately saw a young man who had presented himself at a public hospital complaining of pain in the left knee. He was refused admittance as having no ailment. In a few days he returned, when although *symptoms* only of inflammation were present, he was admitted, and most actively and *apparently* judiciously treated; the case, notwithstanding, proceeded from bad to worse. In another case, where the leg was amputated for an affection of the ankle joint of ten months standing, two fistulous openings indicated the bones denuded to a very slight degree of their periosteum, and the patient, a young WOMAN, was evidently sinking from some cause. When the joint was opened, the synovial membrane was much thickened, and the articular cartilages were of a red colour, and so floculent as to resemble silk velvet. But after all, there was no great destruction of the textures entering into the composition of the joint, and the only excuse which can be offered for the mutilation is, that *no* specific is known for the disease. Now, I ask, did the affection commence in the synovial membrane or in the articular cartilages? I believe few surgeons or pathologists could answer this single question. The articular surfaces presented very much the appearance of the unhealthy granulations in a superficial wound.

103. Injuries and diseases of joints preserved as *dry* preparations (section 39 are as) follows, viz.

A. Anchyloses.

Caries—affecting the articular extremities of bones, in consequence of disease in the surrounding soft parts.

Ivory polish.*

B. *Diseases of joints preserved as wet preparations.* (Sections 7, 8, and 9.)

Dislocation—whether of recent or old standing.

New joint.

Inflammation of the synovial capsule.

Gelatinous degeneration of the synovial capsule.

Inflammation of the cartilages of incrustation.

Ulceration and erosion of the cartilages of incrustation.

Loose, or moveable bodies in joints.

Ganglia.

104. Under the terms cartilage or gristle, or fibro-cartilage, most anatomists include,—1*st*, That substance which covers the articular extremities of bones, whether moveable or immoveable. 2*d*, That elastic substance which connects the ribs to the sternum. 3*d*, In the extremity of nose or snout. 4*th*, The larynx and trachea. 5*th*, Forming the figured portion and tube of the ear. 6*th*, In the eyelids. 7*th*, Those cartilaginous bodies in the temporo-maxillary, sterno-clavicular, and femoro-tibial articulations. 8*th*, Those substances found between the bodies of the vertebræ, &c. It is very evident that if we have in this list analogous substances, they present very peculiar and striking differences in appearance, and accordingly they present great variety under diseased action. They are liable to inflammation and its effects, such as ulceration, erosion, &c., and this constitutes one of the most dangerous affections of joints. The sterno-costal cartilages, the larynx and trachea seem in the natural

* Of the enamel polish on the articular surfaces of bones, I have prepared a great number of preparations deposited in the museum of the Royal College of Surgeons, and also in the museum of the Old Surgeons Hall. The "ivory-like induration" will always precede the polish and *succeed* the entire disappearance of the cartilages of incrustation, so that the change of the cartilage into this appearance, though the common theory, is not the true one.

progress of years to become bone; whilst those of the ear, nose, eyelids, &c. very fortunately never ossify under any circumstances. The best mode of preserving these textures is by drying (sect. 29), and if *no* varnish is used they may be restored to their original state at any time by simple immersion in water. This the anatomist will observe is a property almost peculiar to cartilage. Membraniform textures certainly admit of being dried and restored to their natural state by immersion in water, but to a much more limited extent than cartilage.

105. Tendons are not very liable to disease, and we have few preparations of them in museums. They are sometimes torn by machinery, and ruptured by any violence; and their mode of union forms an interesting subject of investigation. Where they are exposed to friction, a bursa is always provided to prevent the injurious effects that would follow the want of an antifriction apparatus; and in a preparation now before me from the horse, the effects of friction *without synovia* is well illustrated, the texture is unravelled. The texture appears to have *no* disposition to become ossified, at least in man. The patella and other sesamoid bones are *not*, as most suppose, ossified portions of tendons, but are developed in a fibro-cartilage formed at the very earliest periods of the growth of the fœtus, and precisely similar to those portions of the skeleton called epiphyses, observed forming the articular extremities of bones, and remaining separate portions of bone for many years; indeed in many remaining separate for the whole period of life, as our museum contains a great variety of fully formed adult bones where all these epiphyses are separate. Upon this fact it is probable that all the curious phenomena observed in certain cases of disease, such as necrosis, depend. I should think, if these epiphyses have no ossific union with the shaft, they will not sympathise with the disease of the shaft; whereas, if they have permanently united, there can be no doubt that the whole then forming one

unique bone may become necrosed, and be regenerated, provided the progress of death be *slow*.

106. The ligaments are not much subject to disease, and are only interesting in a pathological view as connected with dislocations. In most works on general anatomy, the periosteum and fasciæ are considered under the same head as the ligaments. The periosteum forms, however, the most leading feature in the pathology of bone; and in our section on the preparation of natural skeletons, it is the texture which occupies nearly the whole of our attention. Ossification of those prolongations of the periosteum called ligaments are extremely common, whilst the ossification of a true ligament would certainly form one of the rarest preparations.

107. The muscular tissue is in fact a compound and extremely complex texture, and few diseases proper to the real muscular fibre are to be seen in museums. The muscles in paralytic subjects lose entirely their muscular character, and become a white ligamentous-looking substance. In the private collection of Dr Knox the conversion of the psoas muscle into bone is preserved; this was found so complete, that I preserved it by simply drying it. The external wall of the left ventricle of the heart converted into bone, is also preserved in Dr Knox's museum, and ossific deposit in the arteries is very common. A variety of parasitical animals are found in the human muscles; but these seem merely to have their habitat in the organ, without producing any pathological or morbid effects upon it. This, however, forms a most interesting field of inquiry for the anatomist, and whenever found, the muscle and the parasite should both be most carefully preserved in alcohol. See sec. 170, &c., on the use of the microscope.

108. Amongst the many, and, I may add, the all important diseases and affections of the Brain, and nervous system in general, we find few preparations in museums.

I remember a few years ago this fact seemed to have led to the supposition that disease in this texture was rare. The very reverse is the fact, and the cause of the still existing scarcity of morbid appearances *as preserved preparations* is evidently owing to the general want of anatomical knowledge,—the difficulty of first procuring, and then investigating, diseases of the nervous system,—and, lastly, the almost universal want of the knowledge of the mode of preparing and preserving *wet* preparations, which in all morbid affections of the nervous system must of course be had recourse to. Nine-tenths of the preparations in museums are the product of the dissecting room. Now the nature of dissection in Britain renders the investigation of the nervous system almost impossible.

109. The effects of external injury come often under the investigation of the anatomist, but these, when recent, scarcely afford any thing worth preserving. Recovery after fracture of the cranium is so rare that I cannot say I have ever seen a distinct case of osseous union of the cranium after fracture; not that the bones of the cranium will not unite, but that the injury on the brain which accompanies fracture of the bones is generally so great as to destroy life.*

110. *Injuries and diseases of the brain preserved as wet preparations* (sec. 7, 8, 9.)

Fungus cerebri.

Inflammation.

Coagulable lymph on the surface of the brain.

Apoplexy, or blood effused into the substance of the brain.

* It has always appeared to me that the knife used for dissecting the brain is a very faulty instrument, and I for some time have used an instrument made on the principle of a bow-saw, substituting a fine wire instead of the saw. By this means I am enabled to take off the upper part of the hemisphere of the brain, and display the lateral ventricles in a clearer manner than I had ever seen done with the brain knife. I have not as yet perfected the instrument, and therefore only at present mention the invention.

Abscess in the substance of the brain.
Tumours in the cerebral substance.
Scrofulous tumours in the brain.
Ossification of the arteries of the brain.
Tubercular deposition.
Cysts.
Hydatids.
Hydrocephalus, acute,*—its effects upon the cerebral substance.

111. The membranes of the brain are liable to the following injuries and diseases, and are preserved nearly without exception as *wet* preparations:

Laceration of the dura mater accompanying fracture of the skull.
Tumours connected with the dura mater.
Inflammation, and its effects.
Diseased condition of the dura mater resulting from diseased bone.
Ossification of the dura mater.

112. The medulla spinalis is liable to the following injuries and diseases, and are also preserved as *wet* preparations (sect. 7, 8, 9):

Scrofulous tubercles.
Tumours.
Inflammation and its effects.
Spina bifida.
Compression from fracture of the spine. †

* In chronic hydrocephalus, the brain will of course, if possible, be minutely examined, and any diseased structure which admits of it preserved in alcohol. The effect on the skeleton is often wonderful; the bones must of course be macerated. A section of the skull should be made, and no attempt to separate the sutures resorted to. With one exception perhaps, the finest specimen of this disease is in the Museum of the Royal College of Surgeons (Table No. I. 907). I have already alluded to the preparation and preservation of this specimen in my Introductory Remarks, page 6.

† In a fatal case occurring after fracture of the cervical vertebræ,

113. The membranes of the medulla spinalis are most important, and no doubt subject to similar diseases as those of the brain. They are difficult, however, to get at, and are consequently rare in museums.

114. The spinal nerves, when found diseased, are all preserved as *wet* preparations (sect. 7, 8, 9) :

Inflammation and its effects.
Tumours arising from external injury.
Tumours which form on nerves after being divided, as in amputation, &c.
Subcutaneous nervous tubercles.
Hypertrophy and atrophy of nerves.

115. The sympathetic system of nerves are no doubt liable to a variety of diseases ; but the very elementary-*descriptive* anatomy of this complex nervous system is not as yet clearly understood, many excellent anatomists having committed the most ridiculous mistakes in investigating its pathology. Of course, until the anatomy is perfectly clear, there can be little physiology to be depended on ; and I am afraid, from the difficulties attending most *post-mortem* examinations, our museums will never have many preparations of this most interesting system of nerves to boast of.

116. The various membranes and humours entering into the composition of the eye-ball, and indeed all its appendages, form an exceedingly interesting cabinet in a private collection. If composed of the eyes of quadrupeds,

and which I had an opportunity of examining and preparing, the medulla spinalis presented not the slightest appearance of laceration, although it was evident a fractured portion of the articular processes of the fourth vertebra was driven in towards the spine. The examination was conducted of course with the greatest care, and the medulla spinalis examined under water: a distinct depression corresponding to the fractured portion of bone was observed; and the preparation being instantly put into spirits, the depression still remains. It was in all probability the more immediate cause of the instant death which followed the accident, as the vertebral arteries were sound, and the brain presented no pathological appearances.

fishes, &c., the non-professional will look at and admire them. The mechanical philosopher and the optician take the deepest interest in such a cabinet; and the young anatomist, for some years at least, will find it not a little to his advantage (having *himself* prepared such a cabinet), to demonstrate to his friends an organ of sense which yields to none in interest, and the description of which, as I have already observed, will be listened to and understood by thousands who are not professional. The eye will in all cases require to be dissected and prepared quite fresh, otherwise, although put in alcohol, the interior after a time will be found in a state of decomposition.

117. The morbid affections of the eye-ball and its appendages, although very numerous and important in a surgical view, do not admit of preservation to any very good purpose. Most of the humours and membranes in the eye are, in a state of health, transparent or semitransparent. Now the immersion of these in alcohol renders them opaque, and thus produces just what happens in the greater number of the diseases to which the organ is liable.

118. The injuries and diseases of the Eye can only be preserved as *wet* preparations, and are as follows:

Inflammation and its results.
Cancer.
Melanosis.
Fungus hæmatodes.
Cataract.

119. In sections 52. and 53. the mode of preparing that part of the temporal bone which is more immediately connected with the organ of hearing, is treated of. Morbid affections of the 7th pair of nerves are not uncommon, and possess the highest interest; but few preparations of these exist. The investigation of disease in the organ, though known previous to death, necessitates

a minute knowledge of anatomy; and, in the subjects brought into dissecting rooms extensive disease may in reality exist without ever being discovered. The pathology, therefore, of this *sense* is perfectly open for investigation to the anatomist, and good preparations would be exceedingly valuable.

120. The regular practitioner treats diseases of the organ of hearing so badly, that the practice is at present actually in the hands of empirics; most persons apparently supposing that complaints in this part of the body are to be cured by magic.

121. The diseases I have hitherto observed are mostly of the temporal bone, simply as a part of the cranium, viz.—

Caries of the temporal bones, arising from abscesses which are apt to form in the mastoid portion of the bone.

It is well known that extensive changes in the temporal bone may take place, with little or no injurious effect on the organ of hearing; so that I should suggest for future observers the propriety of directing their attention distinctly, on the one hand, to the pathology of the auditory nerve, and on the other to the temporal bone simply as a component part of the cranium.

122. The Nose has its peculiar diseases. Three sorts of polypi—the mucous, malignant, and fibrous—are spoken of by surgical writers; their pathology is not well understood, and they should be carefully examined by means of sections, &c., and ultimately preserved in alcohol. The bones entering into the composition of the nose and its passages are subject to congenital deformity, and to syphilitic caries; and if the anatomist's wish is to preserve the effects of the disease on the osseous textures, of course *maceration* must be had recourse to.

123. The antrum communicates with the nose, being lined with a continuous mucous membrane; it is of course

liable to similar diseases. The morbid affections of the antrum are mostly unfortunate in their results ; and when an opportunity occurs of examining them, they deserve the deepest attention from the surgeon. Few good preparations either of the nose or antrum are preserved in museums. Indeed I do not remember of seeing more than one specimen, where the attention of the dissector had been directed to the effect of a tumour connected with the *dura mater* upon the olfactory nerves. This was in the true spirit of pathological investigation. The tumour in itself was of little or no value, whilst the description of its effects upon the organ of sense in the immediate neighbourhood was of the very deepest interest.

124. The Tongue, viewed as the organ of taste, seldom exhibits a pathological state; at all events, I have met with no dissections of the third branch of the fifth pair of nerves in a case where the sense of taste had been lost. The tongue, as a portion of the body, is subject to—

Cancer.
Polypi connected with it.
Tumours connected with it.

125. The descriptive healthy anatomy of the Skin being not very clearly understood, its physiology of course cannot be said to have an existence, and its diseases as a texture of the body, and not as an organ of sense, are so multifarious, that I observe most students consider even the recollection of the *terms* employed to be a hopeless task. The skin of the whale forms at once a most interesting subject of inquiry, and shews us many of the component parts of the common integuments on a great scale. The skin of the common porpoise, dolphin, &c. is the same as that of the great whale, and the anatomist can therefore find no difficulty in procuring a portion of the integument of one or other of the Cetacea. The examination in every case must be conducted with the pre-

paration under water, as without this the most important connection, viz. that between the cuticle and cutis, will be but imperfectly seen. As the organ of touch, I am not aware of any pathological condition of the skin, as connected with the nerves of sensation, which can be preserved, except, indeed, we were arranging under this head various diseases which I have classed under the section on the nerves (sect. 109). I shall, therefore, give a list of the morbid states of the skin as a texture of the body admitting of preservation to any good purpose, first treating of the circulating and respiratory systems.

126. The Heart and Arteries are liable to important congenital aberrations, and to a great variety of diseases. These diseases are so modified by age, that a morbid state which is scarcely considered pathological in age, constitutes a fatal disease at an earlier period of life. There can be nothing more simple than the anatomy of the heart, provided the student will examine it for himself repeatedly, and above all trace the circulation over and over again, so that he may be able to distinguish the cavities in the dark. The anatomist should accustom himself to apply a ligature round an artery, so as to obtain a knowledge of the degree of force requisite, and the effects of the ligature on the vessels. The dissection of the tunics of an artery forms an interesting preparation. It will be best done by passing a glass tube within the vessel, so as to distend it, and then with a sharp scalpel lay down successively the *outer* and *middle* tunics, leaving the *inner* entire, preserving it in alcohol (sect. 7, &c.) The healthy appearance of the valves, and their uses, should be perfectly known. With this knowledge the anatomist can inject the whole heart, or whatever portion of it he desires; and when filled with coarse injection (sect. 23) the whole organ dries readily. Except as a diagram, however, I never thought much of injected hearts; they must be most unnaturally distended by

the modes generally resorted to by injectors. Now, we shall find that, to have a correct idea of the size of the heart, constitutes no small part of the knowledge of the pathologist. In investigating the morbid conditions of the organ, a probe-pointed pair of scissors should be used, and the vessels and cavities opened with the same care as if intended for preservation. By following this course, that which has been cut will at once be distinguished from a ruptured part; and as our knowledge renders the organ as it were transparent, we can direct the probe-pointed scissors so as not to divide awkwardly any of the delicate internal structures. I recommend most particularly this systematic mode of dissecting the heart, from observing how few of those forming parts of museums are satisfactory preparations. The dissection being made, the various cavities should be stuffed with cotton, and hardened by immersion in alcohol for a few days. When finally put up, the cotton may be removed, —the morbid part displayed by means of portions of glass, whalebone or any other material, according to the taste of the anatomist. The following morbid appearances are preserved in most museums, nearly without exception as *wet* preparations:

A. *Diseases of the Heart.*

Rupture from external violence.
Inflammation and its effects.
Abscess.
Ossification.
Hypertrophy and general or partial dilatation.
Scrofulous tumours and tubercles in the substance of the heart.
Melanotic tumours in the heart.
Fungus hæmatodes of the heart.
Rupture of the parietes.
Polypi.
Contraction of the auriculo-ventricular orifices.
Valves thickened.

Excrescences connected with the valves.
Congenital deficiency more or less extensive in the septum ventriculorum.
Deficiency in the septum auriculorum.

B. *The Pericardium is liable to—*
Inflammation, when the sac generally becomes more or less obliterated.
Tumours attached to.

C. *The valves of the Aorta, and occasionally those of the pulmonary artery, are liable to—*
Ossification.
Cauliflower excrescences attached to.

D. *The Arteries are subject to—*
Aneurismal dilatations.
Aneurism arising from rupture of the inner coat.
Ossific degeneration.*
Spontaneous obstruction.
Complete obliteration.
Appearance of an artery after the application of a ligature.
Appearances of an artery after amputation of a limb.

127. The Veins are liable to inflammation, and their pathology may be considered quite in its infancy. It is only of late years that these diseases have received much attention, but are at present interesting all pathologists. Their investigation and preservation requires great nicety, and should be made with the least possible delay after the preparation has come into the hands of the surgeon. I have found a very delicate pair of probe-pointed scissors most useful in opening up vessels. Care must be taken, however, in keeping the probe-point close to the tunic which it is wished to divide, as otherwise the delicate coagulable lymph or pus, which may constitute

* This disease will be well displayed by following the directions given in section 11th.

the very essence of the disease, will be pushed before the scissors. It is a well understood pathological fact, that dilated veins, *i. e.* a varicose condition of these vessels in the limbs of stout persons, produce ulcers which are extremely difficult to heal, indeed nothing will heal them but the obliteration of the vein; the ulcer being, in fact, a mere consequence of the varicose condition of the vein. Museums generally contain plaster casts of these ulcers, and it is perhaps the best way of displaying the pathological condition. The only mode which I can devise of preserving the tumour called *nævus maternus* (and which in truth is simply a congeries of veins and arteries communicating with each other) is, first to wash out the blood by means of a syringe, and repeatedly changing the water in which the specimen must be first put. A quantity of spirits of wine should then be injected into the tumour, and the whole immersed in the spirit. After hardening, a section should be made, and finally put up as a wet preparation (sect. 7). In all cetaceous animals we find a prodigious quantity of this remarkable structure as a natural and perfectly organised texture in them, although constituting a disease in the human subject. The late John Bell was not aware of this fact, although it was he who first discovered and pointed out the true nature of the nævus maternus, and gave the disease the name of Aneurism by anastomosis.

128. The Blood, when drawn from the living subject whilst labouring under inflammatory diseases, presents remarkable appearances. The clot shews what is called "the buffy coat." Whilst Assistant Keeper of the Museum of the Royal College of Surgeons, I made a section of a clot in a case of this kind, and the preparation is really an extremely interesting one,—it shews the "buffy coat" to perfection. The coagulum of blood found in aneurismal sacs is of the same nature as the clot which is formed in blood drawn from the arm during life; in

cases of aneurism, however, it is arranged in concentric layers, and not as a homogeneous mass. A clear section made with one sweep of a powerful knife will exhibit perfectly the whole structure and mechanism of the clot found in aneurismal tumours. They are of course to be preserved in spirits.

129. The diseases incident to the organs of Respiration form a large division in most museums. The anatomist must be perfectly familiar with the healthy anatomy before pathological investigation can be of the slightest service to him: this fact is peculiarly applicable in investigating the pathological conditions of the organs of respiration. The structure of the lung, healthy or morbid, will be best displayed by making with a very sharp brain knife a single longitudinal incision, extending from top to bottom, and penetrating nearly through its whole thickness. The larynx and trachea will be best examined by dividing its posterior aspect throughout its whole length, as most of the important structures in the interior are thus left uninjured.

130. The Larynx, Trachea, and Bronchi, are subject to the following affections admitting of being preserved, and the mode adopted is nearly without exception that of *wet* preparations (sections 7, 8, and 9).

Wounds of the larynx and trachea.
Foreign bodies lodging in the tube.
Ossification (this may be dried simply, or preserved according to the rules given in sect. 11).
Inflammation and its effects.
False membranes on the mucous or inner surface.
Tumours connected with the inner surface.
Abscesses.
Congenital aberrations.

131. The thyroid body and bronchial glands are generally considered as appendages to the trachea and bron-

chi, and an enlargement of the thyroid is not uncommon. Every opportunity of examining the nature of the enlargement should be most carefully recorded and preserved, as, although the tumour may in itself be simple, yet its particular locality renders it a dangerous affection.

132. The Lungs and Pleuræ are subject to a great variety of diseases, and from their vast importance in the economy merit the deepest attention. Careful pathological investigation and extensive anatomical museums have most unquestionably done more for the amelioration if not the cure of diseases of the lungs, than any other section of the body. It will be found, however, extremely difficult to preserve the morbid appearances presented. The specimens, when procured, should indeed be macerated in water but for a very short time. The melanotic deposit, for instance, is actually soluble in water; and the blood, in a case of apoplexy, where the death of the person has been sudden, will of course be extracted by immersion in water. The immersion in alcohol has, it will be particularly observed, a much more powerful effect in corrugating one texture (the cellular) entering into the composition of the organ than another. In all cases the disease should be carefully pointed out by means of bristles, &c. previous to finally closing in the preparation, or even putting it amongst alcohol. I have succeeded in preserving the appearance in apoplexy, tubercles, &c. by securing a *thin* slice of the diseased lung on a wax tablet previous to being put into the alcohol; by this means I perceive the sudden corrugation of the cellular parenchyma of the lung is prevented, at all events from contracting the whole section, and the tubercles are brought prominently into view. The diseases admitting of preservation are all to be kept as *wet* preparations, and are as follows:

A. *The Pleuræ are subject to—*

Inflammation and its effects, *i. e.* partial or complete obliteration of the sacs by means of coagulable

lymph being effused on the surfaces of that which lines the ribs, and that which covers the lungs.

Ossific deposition in consequence of chronic inflammation. (This preparation may be preserved as directed in sect. 11.)

B. *The Lungs are liable to—*

Rupture by a fall.
Inflammation.
Abscess.
Hypatization.
Apoplexy, complete or partial.
Mortification.
Soft pulpy tubercles—lately shewn by myself to be cases of apoplexy not terminating fatally.
Empyema.
Emphysema.
Hydatids.
Melanotic deposition.
Scrofulous tubercles.

133. The diseases of the skin which admit of preservation are mostly connected with the cuticle, and are either preserved in *alcohol,* or, if of a horny nature, and admitting of it, they may be *dried.* Sections of the hairy scalp, and the cuticle on the sole of the foot, form the best subjects in human anatomy for investigation and preservation. All dissections of the skin should, if intended to be minute, be conducted if possible with the part under water. If requiring the aid of the microscope, the glass used by the watchmaker will afford the anatomist the *safest* and best magnifying power, and will leave both hands free for dissection.

134. The diseases admitting of preservation to any good purpose are all preserved as *wet* preparations, and are as follows:

Warty excrescences.

Cheloid tumour.
Cartilaginous tumour.
Ulcers.
Cancer.
Melanosis and medullary sarcoma.
Appearance of cicatrix, following incisions, ulcerations, and burns.
Gangrene (preserved by simply drying).
Diseased and *a-normal* appearances of the nails.
Nature of corns.

135. The transition from the skin to the mucous membranes forms a most happy arrangement; and a glance at a series of well prepared preparations (provided the knowledge of the student is of a *practical* nature), is superior to all the read lectures or lengthened printed descriptions in the world. The anatomist should see the mucous membrane injected, and, for this purpose, about 6 or 8 inches of the small intestines, including as much of the mesentery as possible, should be taken. The arteries are readily found, and the injection mentioned in sect. 15 made use of. No very great force must be used in injecting, but if effusion should have taken place into the interior of the gut, the injection will be readily removed in flakes by means of the flat blunt head of a silver probe. The preparation may be floated in pure water for a few hours, and then preserved in alcohol (sect. 7). This preparation will exhibit the villous nature of the mucous membrane, and the arrangement of the valvulæ conniventes. The arteries and veins can be injected very minutely from any of the large trunks, and previous to the removal of the intestines from the body with the injection (sect. 16), the gut distended with air and dried. The investigation of the morbid changes affecting the stomach and intestines, can only be conducted in a proper manner with the *intestine* scissors, now sold by every cutler.

136. I need scarcely remind the anatomist how essen-

tial it is to be fully acquainted with the appearance of the sound or healthy mucous membrane, before he can judge of the actual appearance of disease. It will be recollected that few can possibly see the interior of the gut in a healthy living animal during life. Even when opened by the surgeon in unfortunate cases of hernia, the intestine is *seldom* in a sound state. Experiments on the lower animals are cruel, and not to be countenanced; and, above all, the results tell us nothing of the real state of the *human* mucous membranes.

137. It is probable that important discoveries await the anatomist's investigation of the various entozoa infesting the interior of man and other animals. We have, I am convinced, only seen the larger kinds; and the use of the microscope, I am quite satisfied, will produce wonders in this department of pathology.

138. The Alimentary Canal is most properly considered as commencing at the lips, where, in fact, the common integuments of the body undergo a certain modification, and that modification is evidently principally connected with the *cuticle* and the hairs. I consider the teeth as modifications of the osseous system, and have already treated of these under section 100. The mouth is subject to congenital deformity; the investigation of such are most interesting to the physiologist, and deserve the most careful dissection and preservation. The following diseased appearances are to be preserved, nearly without exception, as *wet* preparations (sect. 7, 8, 9, &c.).

A. *Diseases of the Lips:*
Cancer?
Congenital deficiency.

B. *Diseases of the Palate:*
Tumours connected with.
Congenital deficiency either in the soft or hard palate.

C. *Diseases of the Salivary Gland:*
Tumours—mild and malignant.

D. *Diseases of the Pharynx and Œsophagus:*
Inflammation.
Ulceration.
Obstruction from enlargement of neighbouring organs.
Stricture from swallowing poison.
Foreign bodies lodging in.

E. *Diseases of the Stomach:*
Congenital aberration in form, both as contractions and dilatations, pouches, &c.
Inflammation, from various causes.
Ulceration.
Perforation.
Scirrhous thickening of one or all of the tunics.
Gelatinization.
Tumours and excrescences connected with the inner surface.
Small-pox pustules.
Tunics dissolved by the gastric juice.*

F. *Diseases of the Intestines:*
Inflammation and its effects.†
Adhesions.
Ulceration.
Scrofulous affections.
Scirrhus.

* This is a post-mortem effect, and the discovery of this was one of the splendid results which flow from practical research. It is a singular coincidence, that the cardiac end of the stomach in the rat and other allied species is always extremely thin, and will form a very probable source of error to the purely human anatomist.

† Inflammation when recent, of course, cannot be preserved to any good purpose as a wet preparation; and the part should, therefore, be dried by means of artificial heat, unless it should happen to be June weather, when the sun and air will dry it to much greater perfection than any roasting process.

Dilatation.
Spasmodic contractions.
Small-pox pustules.
Intus-susceptio.
Internal strangulation of the gut.
Artificial anus.

G. *Diseases of the Rectum :*
Congenital deformity.
Structure.
Scirrhous contraction.
Uleration.
Piles.
Fistulæ.

H. *Diseases of the Peritoneum, Mesentery, Mesenteric Glands, Omentum :*
Inflammation and its effects.
Tubercles connected with the peritoneum.
Tumours connected with the peritoneum.
Mesenteric glands, scrofulous—earthy or bony—cancerous.
Omentum having numerous small tumours attached to it,—tubercular.

139. *Hernia.* The frequent occurrence of this accident, and its dangerous effects, affords abundance of opportunities of pathological investigation. A plaster of Paris cast should, if possible, always be taken of the part before dissection, or even in cases which do not terminate in dissection. Many preparations preserved in museums are simply dried, but few good pathologists care for these, and are only satisfied when the parts are preserved as wet preparations. So much displacement and imposture might be practised in the process of drying, that I confess I have always preferred studying the *wet* specimen. The leading object of anxiety

on the part of the surgeon, when called on to operate, is the position of certain arteries with regard to the protruded intestine, and it is therefore most desirable that the arteries, if possible, should be injected; and if this is done, the specimen will admit of being preserved as a dry preparation (sect. 29). The wet preparations in this affection are all necessarily very bulky, rendering it impossible for any private individual to preserve them. I should strongly recommend sketches to be taken, and a clear anatomical description of the parts added. If, to be preserved to any good purpose, they must be dissected,—displayed by stuffing and the use of bristles, bougies, &c. and finally put up without the least delay, their immersion in spirits previous to this being done, renders it impossible subsequently to make any thing of them. Teachers of anatomy, in describing the parts involved in hernia, of whatever description, have indeed the recent dissections before them, and more especially of the pelvis well prepared as a natural skeleton, *i. e.* with all the ligaments present. The skeleton is seldom or never laid aside. Vascular dried preparations I have found exceedingly useful in attaining a knowledge of the nature of hernia. The arteries being injected, Poupart's ligament, together with about three inches of the abdominal muscles more immediately connected with that so named ligament, should be preserved; a bougie should then be passed along the inguinal canal, imitating the course of the spermatic cord, and with very little more dissection the parts dried as directed in sect. 29. The contents of the abdomen may protrude at a variety of places, and the nature of the accident will be modified much by position. The herniary sac will differ in almost every

case, and the contents of the sac will of course present a vast variety of modifications. Herniæ are also classed into those which are reducible,—simply irreducible,—and strangulated. The careful investigation of the elementary healthy structure, led Hunter to the discovery of the true nature of congenital hernia; and I conclude this section by remarking, that constant practice in dissection will alone enable the surgeon to operate with safety in all kinds of hernia.

140. Morbid and a-normal appearances of the Liver—*mode of preservation sect.* 7*):

Rupture.
Inflammation either of its substance or investing membrane.
Abscess.
Tubercles of various kinds.
Ulceration.
Hepatization.
Melanotic deposition.
Ramollissement.
Apoplexy.
Hydatids.
Cysts.
Ossific deposition in.
Worms in.†

* The instructions given in sect. 132. on the lungs will apply to the liver. The alcohol will at first change the morbid appearance on the surface slightly; but after a year or two, a thin slice being taken off, the appearance will be found perfect, and subsequently nearly permanent.

† Baillie seems not to have seen worms in the substance of the liver. In the Museum of the Royal College of Surgeons, Edinburgh, (1898, xxxi. C.), a fine specimen is exhibited of lumbrici in this organ; and I have preserved the liver of a rat with the tænia in its substance.

141. Morbid and congenital appearances in the Gall-Bladder—(*mode of preservation sect.* 7):

Inflammation of one or other of its tunics.
Ulceration.
Ducts dilated, contracted, or obliterated.
Gall-stones.*
Hydatids.
Congenital aberration.

142. Morbid appearances of the Spleen—(*mode of preservation sect.* 7):†

Inflammation and its immediate effects.
Hypertrophy.
Hepatization.
Ramollissement.
Cysts.
Tubercles.
Hydatids.
Congenital Aberrations.

143. Morbid appearances of the Pancreas‡—(*mode of preservation sect.* 7):

Inflammation and its effects.

* Gall-stones admit of being preserved by being simply dried, and are generally stuck on pieces of card, and enclosed in a glass jar. The gall-bladder also dries readily when distended with air, but I consider this rather a coarse mode of preservation, as applicable to this most important organ, the pathology of which it is most desirable thoroughly to understand, and which is by no means the case at present, since the real texture of the tunics of the gall-bladder and biliary ducts have not been completely made out.

† The organ is an interesting one for two reasons; 1st, anatomists have not as yet discovered its use in the economy; and, 2d, it is in this organ where the communication of the veins with the arteries can be demonstrated by dissection.

‡ The scarcity of the diseased pancreas in museums, may possibly depend upon the fact I have observed, viz. that it is very seldom looked at in post-mortem examinations. The gland is certainly not difficult to find in the dead body, but still its dissection, in order to detect disease, necessitates great delicacy, and an unusual extent of anatomical knowledge.

Abscesses in the substance of.
Substance of cartilaginous, hard, scirrhus.
Calculi in.
Congenital aberrations.

144. The Kidneys exhibit a great variety of morbid appearances, and generally occupy an extensive division in our museums. They are readily got at in dissection, and are a convenient size for preservation. They should all be preserved as *wet* preparations (sect. 7).*

Hypertrophy and atrophy.
Inflammation, results of.
Softening (ramollissement) of the substance.
Abscess.
Tubercles in.
Scirrhus.
Hydatids (false and true).
Calculi forming in.†
Congenital aberrations.

* Although the diseased kidneys are numerous in our museums, yet their pathology is not well understood, and this arises evidently from a want of care in the dissector. The kidney is generally felt for, and cut down upon or dragged out willy-nilly; it is then subjected to a sort of baking process, and a very favourite manipulation is to dexterously strip off the capsule. Now, after all this is done, I question very much if the kidney is worth looking at. Should nothing but the kidney be procured in any post-mortem examination, the first step to be taken is to divide the body into two halves by a single incision, commenced on the convex margin of the organ, and, with few exceptions, immediately prepared and suspended in alcohol; the jar should not, however, be finally closed in, so that the spirits may be changed after the lapse of a week or more, when it will no doubt be much discoloured. The true nature and uses of the renal capsules are unknown, and I have only seen one case of disease occurring in this organ. Their pathology will no doubt one day lead to their true physiology.

† The formation of calculi in the kidneys is very common; if small, they pass readily down the ureters into the bladder, but in some cases they stop in these excretory ducts, and the effect is fatal, and at the same time very singular. The kidney continues to secrete the urine, which, not getting down the ureter, accumulates,

145. Morbid appearances of the Urinary Bladder — (*mode of preservation sect.* 7): *

Inflammation of all its tunics at once or separately.
Ulcers on the inner surface.
Scirrhus and cancer.
Fungous excrescences.
Polypus.
Elongation of the inner membrane.
Cysts, pouches, &c.
Thickening of the muscular tunic.
Hernia of.
Calculi in.
Congenital deformities.

146. The disease leading often to most distressing results in the urethra is generally to so small extent, and in fact obscure, that the greatest caution, and a deal of practical knowledge, is required previous to proceeding to the dissection and preparation of the parts. The urethra should be opened up by means of a pair of delicate probe-pointed scissors, commencing at the glans, and carrying the incision along the dorsal aspect of the organ. The diseases of the urethra are preserved as *wet* preparations (sect. 7, &c.), and are as follows:

Congenital aberrations.

producing such pressure on the substance of the kidney as at last to produce its complete absorption. The pelvis and infundibula are found distended into large sacs. The other kidney, in these circumstances, becomes much enlarged, and very fleshy A specimen of this unfortunate mechanical stoppage to the passage of the urine is preserved in Dr Knox's museum; and I mention it to illustrate the necessity of careful manipulation in all pathological investigations. A kidney, the very counterpart of the one in Dr Knox's Museum, is preserved in the Museum of the Royal College of Surgeons, Edinburgh. It was one of that portion of the museum which formerly belonged to Sir C. Bell, and is catalogued as a case of Hydatids. Now, it is evidently no such thing, but the calculi had escaped the notice of the dissector, and were probably lost.

* The observations made on the mode of preserving the diseased state of the stomach and intestines, apply extensively to this section.

Inflammation.
Stricture.
Ulceration.
Abscesses.
Fistula.
Urethral calculi.

147. The Prostate Gland is subject to the following diseases:

Inflammation.
Scrofulous affections.
Scirrhus.
Abscesses in.
Calculi in the substance or ducts.
Pathological enlargement of one or other of its lobes.
Congenital aberrations.

148. Couper's glands have rarely been observed diseased.

149. Urinary calculi are generally preserved by simply drying them. They possess little interest, however, except as connected with surgical operations, and in all cases, therefore, where it is possible they should be preserved *in situ*. Their composition is various. The following list comprises those which are most commonly met with. An analysis of the calculus should invariably be procured, and a section made.

Uric acid.
Fusible calculus.
Oxalate of lime (mulberry).
Phosphate of lime.
Carbonate of lime.
Cystic oxide.
Triple phosphate.
Nitrate of ammonia.
Mixed or compound calculus.
Phosphate of magnesia.

150. There are now a variety of modes which can be resorted to in order to preserve the organs of generation and urine. Until lately, quicksilver injections were deemed the only means applicable for displaying some of the most important structures, such as the gland, vas deferens, &c. A mode has lately, however, been discovered by Sir A. Cooper, of injecting these parts with coloured injections; and what is extremely difficult to be credited, Sir A. declines communicating the secret even to his friends. I have not had the pleasure of seeing any of these very celebrated preparations. I have, however, succeeded in preserving very fair specimens by allowing the part to become very soft, by keeping and repeatedly washing out the vessels or ducts with warm water previous to injecting. The tunic of the *vas deferens,* for instance, is very strong where it crosses the inferior part of the bladder to reach the prostate, and where it is generally divided. When a preparation of the testicle merely is wanted, a much greater degree of force might be applied to the injecting syringe than is safe in injecting the arterial or venous systems; and I rather think that the cold injection, if finely prepared, and the parts allowed to become nearly putrid, might be forced into the vas deferens, the epididymis, or even into the parenchyma of the testicle. An interesting preparation of the glans and the corpus vasculosum urethræ, may be made by introducing a pipe into the *vena magna ipsius penis,* (a probe having been previously passed along the first five or six inches of its course to break down the valves found there), and the injection forced into the vessels by means of a syringe. The injection sect. 21. may be used, but the cold injection is by far the most preferable.

151. The present mode of distending the *corpus cavernosum* with air, has no disadvantage except misleading the anatomist with regard to the true nature of this part of the male organ of generation. The corpus cavernosum being removed from its attachments to the pelvis, is al-

lowed by many to become half putrid; the pipe of a powerful syringe is then introduced into one or other of the crura, and warm water forcibly and repeatedly injected into the part, and this manipulation is repeated until the penis looks like a portion of condensed cellular membrane; a blowpipe is then introduced instead of the pipe of the syringe; the corpus cavernosum becomes distended on air being blown into it, and dries in this distended form; a section is then made, and the interior appears composed of cells of all sizes, formed by delicate septa; and most anatomists of the present day have drawn the conclusion from this appearance, that the corpus cavernosum is entirely composed of cells, and that into these the blood is poured by the arteries in the erected state. Now, the section of the recent human penis previous to any preparation does not present this appearance; and a section of the whale's penis, nine feet in length by about ten inches in diameter, shews us, that in addition to the arteries as in the human, we have veins, dividing so rapidly as certainly to compose a complete net-work of short vessels; but we also have innumerable transverse fibrous bands, running from one side of the fibrous covering of the corpus cavernosum to the other, like the diameters of a circle, and crossing each other in the centre; and, in addition, we have a vast quantity of *cellular membrane* supporting and surrounding the vessels. Now, the existence of this cellular membrane we believe to have been unknown previous to our examination of the whale's penis; and thus it is evident that, if the blowpipe is introduced at random into the crura of the corpus cavernosum, the air may get into the cells outside the vessels, and distend the organ, though not a single trunk of a vessel may be thus distended. In preparing the corpus cavernosum, either in this way or by means of injection, the pipe must be distinctly introduced into a vessel (and which will be a vein unless the arteries are particularly selected) with proper tunics. The corpus vasculosum urethræ, glans, and bulb, are

indeed composed of a complete net-work of veins, with two arteries like the corpus cavernosum in fact, but without the fibrous septa or cellular tissue.

152. In attempting to inject the arteries, great caution must be used, as in all attempts hitherto made the material injected passes from the arteries into the veins, proving most distinctly the communication of the arteries with the veins; but it must also be remarked, that the tunics of the arteries so subdividing get extremely delicate, and are of course easily ruptured; and the injection may thus get suddenly effused into the cellular texture, forming cells for itself, and all the time in neither set of vessels; for having once escaped from the proper vessel, it has much less chance to get into another, but will get diffused through the cellular tissue as in dropsies.

153. Most public museums now contain fine views of the parts of generation, particularly that of the College of Surgeons of Edinburgh, put up mostly with a view of exhibiting morbid changes. They are bulky, and expensive preparations to be put up for the private cabinet; and we suggest, therefore, that the organs should be simply removed, in conjunction with the symphysis of the two ossa-pubis, to which they are particularly attached, cleaned, by after dissection, of the surrounding integuments, and preserved in a close jar amongst proof-spirits: they thus constitute a most valuable and useful preparation. Preserved in this way, the parts bear a great deal of manipulation,—may be studied over and over again,—and the catheter may be passed along the urethra, if done with caution, as often as the student has a mind. This manipulation will not, indeed, enable the surgeon to pass the staff or catheter in the living body, but it will give him a vast deal of information which can neither be obtained in practice on the dead nor living, previous to the removal of the parts from the body.

154. The whole pelvis, including the pelvic viscera, may be taken, and, being placed in spirits of wine for a short time, will acquire a sufficient hardness to allow of

a mesial section being made, not only of the bones, but the various organs contained therein, or the left os innominatum (leaving the symphyses pubis entire), may be simply removed, and also leaving the levator ani muscle of the left side. This section every surgeon ought, and easily could have at all times in store. Great care has been bestowed by persons engaged in getting up museums, in preparing these sections for exhibition; and stuffing with curled hair, or by means of spirits of wine, distending the bladder and rectum previous to making the section. This gives a very erroneous view of the natural condition of the pelvic viscera during life, and can only be admired by surgeons, as we would say, of the Old School. It would be very unsafe to draw any practical deductions from views of this kind of preparation.

155. Morbid appearance of the organs of generation in the male—*mode of preservation sect.* 7.

A. *Testicles and their ducts*—
Scrofulous.
Enlarged and pulpy.
Small and wasted.
Scirrhus.
Fungus hæmatodes.
Osseous.
Abscesses.
Hydatids.
Adhesions in the vaginal sac.
Loose cartilages.
Hydrocele.

B. *Spermatic Cord*—
Scirrhus.
Veins, varicose.
Dropsical collections in.

C. *Vesiculæ Seminalis*—
Inflammation of.

Scrofulous affections of.
Scirrhus.
Calculi in.
Congenital aberrations.

D. *The Penis is liable to—*
Congenital aberrations.
Inflammation, producing phymoses, &c.
Warty excrescences.
Cancer.
Syphylitic ulceration.
Induration of corpus cavernosum and corpus spongiosum urethræ.

E. *The Scrotum is liable to—*
Cancer.
Tumours connected with.
Vast general enlargement, as in the famous case of Loo Choo.

156. The generative organs in the female present such a variety of pathological appearances, that their preservation alone forms a large collection. The Hunterian Museum in Glasgow, formed by Dr William Hunter, still contains many fine preparations. It will be observed, in examining this collection, that Dr Hunter was fully aware of the superiority of an ample glass jar. The healthy anatomy mostly admits of preservation according to the rules given in sections 6, 7, &c. I observe, that Dr Hunter had been at great pains in adopting various modes for distending cavities, as the gravid uterus, &c. and that portions of quills, with little wooden stoppers, have been used, in order to distend these cavities repeatedly, until fairly hardened into shape. In preparing for preservation either the uterus or ovaries the sections made should be clear, and, if possible, done at one stroke of the knife. The structure, particularly of the ovaries, is best shewn by one single longitudinal section.

A great many of the pathological appearances in these can only be preserved by means of drawings or modelling, their bulk rendering them extremely expensive to preserve in any other manner. I remember of a fibrous tumour, connected I think with the uterus, being sent to the Museum of the Royal College of Surgeons of Edinburgh, which a large sized washing-tub did not contain. The donor insisted on its being preserved *entire;* and I opposed this, first, from the enormous expense; and, secondly, it appeared to me that a section, and that a small one, was all that was required, the entire mass presenting evidently one uniform character. This mode was instantly adopted, upon its being ascertained that it would be next to impossible to procure a jar of sufficient dimensions. Now, had I been the donor of the tumour, I should previously have taken care to get a correct drawing, or a cast, made of the body, with the tumour *in situ,* before dissection; the mass then weighed; and the full details sent to the museum which I wished thus to benefit by my exertions. Instead of this, the details of the case even were not forthcoming.

157. Morbid appearances of the generative organs in the female—*mode of preservation sect. 7.*

A. *Ovaria*—
Enlarged and altered in structure.
Shrunk and altered in structure.
Dropsy.
Scrofulous tumours, mild and malignant.
Congenital aberrations.

B. *Fallopian Tubes*—
Adhesions.
Dropsy.
Tumours.

C. *Uterus*—
Ruptures.
Inflammation of one or all of its tunics.

Hydatids.
Polypus.
Ulceration.
Tumours.*
Scirrhus tubercles.
Congenital aberrations.

D. *The Vagina and external parts are liable to—*
Tumours, of various kinds.
Ulceration.
Warty excrescences.
Congenital aberrations.

158. Although both male and female have mammæ, yet these are really female organs.

159. The Mammæ and pectoral region generally are liable to the following diseases, which are all preserved as *wet* preparations :—

Hypertrophy.
Atrophy.
Neuralgia.
Scrofula.
Carcinoma.
Medullary sarcoma.
Gelatiniform sarcoma.
Melanotic deposition.
Fungus hæmatodes.
Cysts.
Abscess.
Fibrous tumours.

160. Malformation very seldom comes under the notice of the anatomist; and hence, when an opportunity does occur, well recorded, authentic cases, are invaluable.

* Tumours of a sarcomatous nature are often developed in the uterus, and sometimes reach a vast bulk. I have also seen many requiring a *saw* in order to make a section of them. I have dried these sections, and then preserved the part in turpentine (sect. 11).

The physiologist, and, above all, the comparative anatomist, will be found to possess a vast superiority over the mere surgeon in all such investigations.

161. I remember, whilst Assistant-Keeper in the Museum of the Royal College of Surgeons, and arranging the Bell Collection, a division had been appropriated in it, whilst in Windmill Street, to tumours, and it consisted only of some six or eight preparations. A remark, explanatory of this, was made in the Catalogue, viz. "That sections of most tumours were of little use;" and added, "that a section of a scirrhous mamma became exactly like a healthy mamma after being immersed for a short period in alcohol." I looked most attentively into this, and found it *not* the fact. If, indeed, the preparation is allowed to become half putrid, by lying amongst dirty spirits for days, and ultimately stuffed into a bottle, barely sufficient to hold it, with the view of saving some glass or two of whisky, then, I admit, that all tumours will be very much alike; but the anatomist must never forget, that the *examination* and *preparation* of diseased structure should follow immediately the *dissection;* and, by the introduction of bristles, &c. the diseased texture pointed out previous to immersion in alcohol or any preservative liquor; and if this is attended to, there can never be the slightest difficulty in distinguishing adventitious or diseased structure from that which is healthy and sound.

162. In most museums the greater number of tumours which are not osseous or aneurismal, are arranged with the integuments. In most cases a section is merely made of the morbid growth, and this should be done at one stroke of a powerful knife; the diseased structure pointed out by means of bristles; and the preparation at once suspended in alcohol. Should (in the course of years) the morbid appearance become obscure, the anatomist will find that the obscurity is superficial. The tumour should be removed from the jar, and a slice, which need not ex-

ceed one-sixteenth of an inch in thickness, taken off, when the morbid appearances will again shew themselves, in more brilliant colours than when the preparation was first put up; and what is most satisfactory, this second section subsequently undergoes little or no change. In arranging various tumours under one section, it will, of course, occur to the student that they must all be connected with some part or organ of the body, and the natural suggestion is, to place them immediately in contact with these organs. But this mode would not answer so well as that of bringing these morbid growths together, whether mild in their nature or malignant. The following are those most commonly met with in practice; and are mostly preserved as *wet* preparations.*

Adipose sarcoma.
Fibrous tumour.
Cartilaginous tumour.
Fibro-cartilaginous tumour.
Cystic tumours.
Scirrhous tumours.
Fungus hœmatodes.
Melanotic tumours.

163. The anatomist and physiologist have, time immemorial, found the investigation into the young of all animals the most interesting and extensive field for minute investigation. In section 78, I have already detailed the mode necessary to be followed in preparing the skeleton. I have here only to remark, that the preservation by means of alcohol (section 7, &c.) is most extensively followed in forming museums; for the reader will be aware that the teachers of midwifery require a very large mu-

* The discovery of the complete prevention of the evaporation of turpentine led me to try to preserve soft textures in that spirit; but, generally speaking, I did not like their appearance. The turpentine is apt to become turbid, and delicate textures were not well displayed by it. I found, however, a considerable number of tumours were well preserved in turpentine. The colour being undoubtedly longer preserved than when alcohol was used.

seum to enable them to fulfil their duties to their pupils in a proper manner. I have known as much as L.300 sterling given for a collection of this sort; and when we reflect that no person can say, "I want a museum to teach midwifery (or any other branch of the profession) I shall have one made within the year," I do not think that the sum paid was too much. Collections of this kind can only be formed gradually, and require many years' hard labour, and much expense, to render them, as I have already remarked, fit to be consulted by any one. Casts and wax-models, &c. form at present a large part of these collections, but I rather think that they are not exactly so invaluable as they were considered some years ago; I am of opinion, indeed, that the museum of most teachers of midwifery are at present made up with erroneous views; and, at all events, there are many preparations which can be of little real utility to the teaching the sound principles of that branch of our profession. Thus it seems to me that the series of fœtuses, put up without dissection, and forming so large a part of these museums, are mere store for the anatomist. The gravid uterus, as seen in most cases, I consider as so much *treasure* locked up, for the present locked up, in fact, in a double sense: first, by means of the key of the museum; and, secondly, by the walls of the uterus being entire. All specific aberrations in Nature's productions unexamined and undissected, are mere objects of curiosity; and *amusement* should never form a feature in an *anatomical* museum. I remember, in assisting to draw up a catalogue of the Barclayan Museum, I was forcibly struck with the vast number of objects of curiosity contained in the collection. Amongst others, a *glass article* kept the whole party laughing for an hour; and I recollect of a bottle actually containing a riddle, made of wood. The misfortune of these things is, that they detract the attention of the young student from matters which require the deepest reflection. Dr Barclay, I am aware, was so fully

occupied with the lectures that no catalogue was kept, and, of course, a systematic arrangement was never attempted; and thus various *nick nacks* crept into the collection, which would have been dispensed with had the Doctor had time to put his magnificent collection into order.

164. But, to return, it is a fact, that most circumstances connected with fœtal life still require vast elucidation. Even the structure and pathology of the placenta (from a recent publication I have read) seems altogether unknown to the present hour. The only explanation I can offer for this is, that the anatomist seldom gets hold of so many parts as to render the careful dissection an object to him. In comparative anatomy ample opportunities occur of investigating fœtal development, but these can only be of service in elucidating any fact not very clearly made out, in human structure, and must never be considered as tantamount to the examination of the fœtus and its growth in the human race. Entertaining these views, I have invariably proceeded to the examination and dissection of every thing connected with this department of the museum, so that I boast of having no single specimen of the human fœtus which does not shew some fact in their anatomy, such as the position of the testicles, appearance of the renal capsules, thymus gland, comparative size of the liver, appendix vermiformis, &c.

PART III.

CHAPTER I.

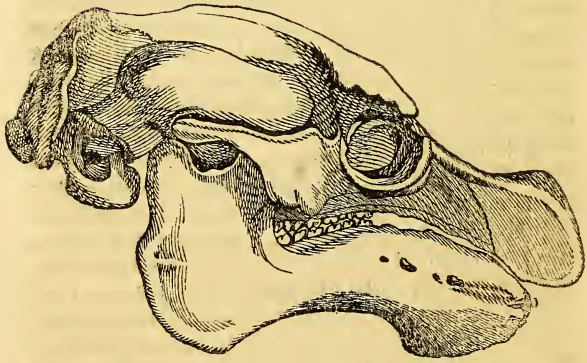
165. On the art of Drawing.—169. Modelling.—170. Use of the Microscope.—172. Hints to Travellers.

165. The art of drawing is of considerable use to the anatomist, not only as it enables him to record what he may have seen, and thus to transmit to posterity his labours in a clear and satisfactory manner (the delineation being accompanied with a concise description); but the very act of representing the object, necessitates a thorough knowledge of its comparative and various parts; engraves it, as it were, on the memory; and, should any false views have been taken up by the anatomist, his successors in the same labours will be at once able to perceive, and thus correct, these errors. I cannot say, however, that I ever derived much benefit from drawings or delineations, however well executed. They can never supersede the necessity of actual personal investigation; and the most useful kind of drawing to the anatomist is the power of giving the simple but correct outline. All other attempts necessitates that degree of perfection in the art which none but the professed artist can possess. Now, the pure artist does not make good anatomical drawings. The object of the artist is *effect*, and the appearance of the hard outline is a sort of abomination in his sight. On the other hand, the anatomist cares not one farthing for effect, and the determinate outline is his

delight. I cannot illustrate this statement in a more forcible way than by introducing here two wood-cuts.

Fig. 5.

Fig. 6.



166. The views here given are those of exact profile, which should invariably be adopted when the object to be represented is naturally small, or upon a reduced scale. *Effect* in this case was not in any way considered, but my object was, to point out the remarkable prolongation of the jaws in certain races of men, and how this prolongation and increase of the upper jaw altered the relative

situation of the nostrils. Fig. 5. is the portrait of the cranium of an American race of Indians, and Fig. 6. that of the Manatee, an aquatic animal.

167. Indeed, in every case the less confusion, and of course the fewer parts which are represented, the better, in all anatomical drawings. In the engraving which I have given of the bantam (Plate, Fig. 1) I was compelled to give what I considered a faulty view, but my object was to give a representation of the *frame*, A, and mode of drying the skeleton. Had I intended to name the various bones of the skeleton I should have given an exact profile, and, *in a separate sketch*, any mesial part which the profile view did not represent, such as the sternum. M. Cuvier, it appears to me, has been exceedingly happy in his representations, particularly in his volume on Whales. The views he gives of the enormous crania are either the exact profile view, or from above or below; and although in some instances the representation is reduced so much as *ninety* times, yet the diminished outline gives a very fair idea of the object. M. Cuvier's drawing of the skeleton of the perch has taken precedence of every other, and has now appeared, without the references being altered, in nearly every periodical, and of all sizes. I do not much find fault with copying a thing which, indeed, is very excellent; but the reduction in size from the original is a serious fault, as all correctness has been lost in so doing; and the student may thus be led to think that, if the work which he has purchased is not a very good one, still he has M. Cuvier's perch. Now, he will find himself very much mistaken: all the copies which I have seen being merely imperfect shadows of the original. Again, I have at this moment lying before me a most excellent monograph, by one of the greatest of surgeons, on hernia. The engravings are from drawings by one of the most celebrated artists, and yet, although I have not the least doubt that the dissections were without fault, and the artist unexceptionable, I never can make out the top

from the bottom, without going over the whole description *verbatim et seriatim*. The representations, in fact, are artist's laboured views of the parts; and the result is a failure. Had the surgeon been able (of which I have no doubt), he would have done his dissection more justice with a common pen and ink, than the artist has done him with all his experience and taste; and yet I do not find fault with the artist,—it is with the attempt to give an *artist's* view of an object which is not, and never can be, familiar to the sense of sight. I have even seen an attempt made to make a *picture* of the dissection of the whole chest, neck, and face, including all the muscles, arteries, veins, and nerves; and to add to the clearness of such *picture*, the tables, blocks, &c., are also introduced, and, as appears to me, the *subject* gradually reaching the ground head foremost. Professor Tiedemann seems to have seen the error of delineations of this kind, and his work on the Arteries will be found based on the principle which I have attempted to enforce in the preceding observations. Fearful liberties, I perceive, are used with these anatomical engravings of Tiedemann, such as omitting some parts, and, what is far worse, *filling* up parts, no doubt with the view of claiming originality. Now this is theft of the very worst description, and consequently a crime which, if not reached by the laws of the country, should at all events be discountenanced in a Christian land. Upon a late visit of Professor Tiedemann to this country, whilst inspecting Dr Knox's private museum, the Professor was shewn some varieties in the arteries, which he had not previously observed, and he requested sketches of them, directing me merely to give the anomalous artery in a finished state, representing all the other parts, such as the muscles and bones, merely in outline. I shewed him some drawings of cetaceous animals; and the arch of the aorta of the dolphin being peculiar in the distribution of its branches, and new to him, I offered him a copy of the drawing, but with the

pen, in a few seconds, he shewed me a perfect copy on the margin of his note-book. It must be admitted, that Professor Tiedemann is no ordinary person, and that the tact and power of touch which he evidently possessed, fully equalled the soundness and clearness of his judgment. On the occasion to which I allude, our museum was undergoing extensive repairs and alterations, and the various preparations very much crowded together, so as not to be easily got at. I must confess my astonishment was not small when I found him, not only seeing at once every thing that was curious and interesting, but reaching them in a manner such as I would have deemed altogether impossible, except by the individual who had so placed them. He seemed to me to know every thing; and although, in a visit lengthened to upwards of two hours, nearly every object in the muscum was not only looked at, but many of them minutely examined, he left the premises in precisely the same order in which they were in on his entrance, and without any thing sustaining the slightest injury.

168. Sir Charles Bell seems to possess, in the very highest degree, the art of the artist; but, at the same time, is fully aware of the superiority of the *clear, hard,* outline for anatomical drawings. I recollect whilst Assistant-Keeper of the Museum of the Royal College of Surgeons, Edinburgh, after the purchase of the Windmill Street Collection, we were looking over a number of sketches in a portfolio, and we found one of the head and upper part of the chest of a boy, who had met with an accident, giving rise to fungus cerebri. Although the outline was the work of pen and ink, and the little colouring mere dashes of the pencil, the nature and effects of the accidents were so perfectly represented, that in five minutes I had it in the hands of a frame-maker, with instructions to spare no cost in preserving it with the handsomest frame he could make. I should therefore recommend the anatomist, by all means, to exercise himself

constantly in the use of the pen, or pencil. It will repeatedly prove to him, that when he imagines that he is perfectly acquainted with every thing about a part, he in reality knows little or nothing. It is also one of the best kinds of short-hand writing with which I am acquainted.

169. Modelling with Plaster-of-Paris is a very useful, and with many a much prized art; a great variety of objects for the museum can be represented *well* with this substance, and its use is very easily acquired. Plaster-of-Paris is sold in every town, and in using it all that is necessary is to moisten it slowly with water, until the mixture is of the consistence of cream, when it must be instantly used. Any colouring matter, such as red lead or Prussian blue, may be added, and may thus be used as an injection. The fluid will *set* in a few minutes, becoming of the consistence of chalk. I have never, however, used it as an injection, as it has always appeared to me to possess very few good qualities for this purpose. The Museum of the Royal College of Surgeons, Edinburgh, possesses some models which have always been considered very fine, and the mode of making which long remained a secret. They simply consist of, 1st, a Paris plaster cast, which is afterwards coloured with coloured wax in a fluid state, laid on exactly like paint. They do look well, but they are evidently very fanciful; and I remember, when assistant keeper, of Baron Larey paying a visit to the museum. I drew his attention to the casts, but he shrunk up his shoulders, shook his head, and would not look at them. The art of modelling trenches upon that of the artist, and, as every one knows, is practised by a number of persons as an art. Professors of this branch of science are in every large city, and I recommend the anatomist to do as I did, viz. visit the studio of the artificer in stucco. All in this line in Edinburgh, at least, I found most communicative, and happy at all times to explain every thing, and much more of the art than the anatomist can possibly ever require. I candidly confess

that twenty volumes (whatever might have been their bulk) would not have given *me* the insight of one hour's sojourn in the garret room of my Italian friend. When the part which we wish to take a model of is nearly flat, presenting no projecting angles or deep cavities, there can be nothing more simple than the process. The part has merely to be smeared with fine lard, or oil and lard in equal proportions, and the fluid plaster run over it to the depth of $1\frac{1}{2}$ or 2 inches, and allowed to harden. This forms the mould, and has to be smeared again with lard, and filled with the fluid plaster-of-Paris, which, when dry, will give the perfect model. The superficial veins at the bend of the elbow, for instance, will require two moulds to be taken, one of the anterior aspect and one of the posterior, taking care that the two will exactly enclose the arm when brought together. These moulds may then be tied together with a piece of cord, being previously smeared with lard. The fluid plaster is then poured into the interior or space previously occupied by the arm. The plaster should be perfectly dry (set) in about ten minutes, and upon removing the cord the mould will open of itself, and leave a model of the arm. A dissection, an ulcer, and even the abdominal viscera, may be modelled in this manner. When, however, it is wished to take the model of the interior, of the cranium for instance, where the cavity is greater than the external orifice or outlet, or where a body projects having a larger circumference than its base, the process becomes a very troublesome and difficult one, and will not, I rather think, be resorted to except by those very familiar with, and in the constant practice of, the art. In both the cases which I have just mentioned, the mould would not *deliver* entire, but would require to be made of a great many portions, so that when taken out, it would only form a model requiring another mould to be made on it, so as to procure a good model. I recollect, in taking the model of the interior of the cranium of the Rorqual giganteus,

the best workmen were all but foiled in the attempt, and, what was worse, the bones of the cranium nearly destroyed. If the plaster is allowed to harden in a cavity out of which it cannot be taken, the mass must of course be broken to pieces, and this is no easy process, requiring great force and violence with chisel and mallet, and such as no right anatomist would like to see applied to any preparation.

170. The Microscope has of late got so much into fashion that the anatomist will find he cannot well avoid resorting now and then to its use. The magnifying powers of the microscope should always, however, be as low as possible, as the frequent employment of one possessing very high magnifying powers is extremely fatiguing,—most injurious to the sight,—and, like most things which are attended with difficulty, extremely apt to mislead; even the professed microscopic observer has been known to commit some strange and ridiculous mistakes.

171. I have had considerable practice with the microscope in investigating the nature of the food of the salmon, char, vendace, herring, &c. The magnifier I use for dissection is a common watchmaker's glass, of 2 inch focus. This glass leaves my hands perfectly free for dissection. The object being placed on a slip of fine window-glass, and a single drop of water placed upon the object, I proceed, with a needle in each hand, with the investigation. If, during this manipulation, any minute object appears which I cannot distinctly see, I immediately place it under the field of a more powerful magnifier. The microscope which I have found in this way to answer every purpose, is one sold by Messrs Adie and Son. It is a small compound microscope, and so perfectly portable, and so easily managed, that the anatomist can have it at all times beside him, and is thus enabled to solve a difficulty so soon as it presents itself,—a most important desideratum in every investigation, but more especially in

microscopic research. During summer for instance, the drops of water in which you may have commenced your dissection, will dry up in a few minutes, and you may subsequently in vain endeavour to repeat the dissection. The common watch-glass forms a convenient sort of cup for dissecting minute objects, but it is not so good as the slip of window-glass, particularly if the object is very minute, and the microscope you are using very powerful; the slightest movement removes it from the field of observation, and you are very apt to bring the magnifier in contact with the water, and in all probability thus lose the object. A few months ago a microscopic entozoon was discovered in the human muscles. The animal was at once microscopic, and extremely complex in its organization, consisting of a sac containing a worm. I was the first in Edinburgh to dissect the sac, and show the worm to Dr Knox's students. I, however, particularly caution the young anatomist against resorting too frequently to the assistance of a magnifier. There are certainly a number of persons whose sight does not appear to be injured by so doing, but it assuredly has a most baneful effect on by far the greater number. To the young mind the microscope presents powerful attraction, and this fact seems to me to render this caution (which, however, I offer with great deference) more especially to be attended to. The sight of the practising surgeon cannot be too good, and if destroyed at an early period of life by the improper use of the microscope, the individual may find himself, when qualified by his acquirements to practise, perfectly disqualified by the imperfection of this most important sense.

172. The anatomist, when in foreign countries, will meet with innumerable objects which he will be anxious to preserve; and I trust that the instructions I have already given will, with a little ingenuity, enable him to do this. About two years ago a collection was brought to sale in Edinburgh, which had been made by a surgeon

in India; and I think I have never witnessed better taste or greater ingenuity and care than was exhibited in the formation of this collection. The individual seems to have been the perfect anatomist, the skeleton having been evidently his primary object. If it is possible, maceration of course should in all cases be preferred to boiling the bones, which indeed should only be resorted to as a last resource, rather than lose the specimen altogether.

173. Animals requiring dissection, and every thing indeed except the skeleton, will require to be preserved in some spirituous liquor; and this should never exceed the strength of proof spirits. Small firm barrels will answer the purpose of the traveller better than any other contrivance; and as the carpenter on board ship is in general a superior and intelligent person, these can often be made in a very short time to suit the object wished to be preserved. The part, previous to immersion in spirits, should be perfectly clean, and a sort of semidissection made, so that the spirit may reach every part. A small quantity of turpentine injected into any of the vessels has a powerful effect in preserving parts. It has been stated to me that common sea-water, where the external air has been perfectly excluded, will preserve fish and molluscous animals for a very great length of time; but I have not myself ascertained this fact, and should not like to trust any valuable preparation or natural object to such means of preservation. It might with care, however, be tried. The following solution preserves the soft parts of animal bodies in a very favourable state for subsequent dissection.

174. ℞ Alum, ... ℥j.
Common salt, . . ℥viii.
Soft water, . . . ℥viii.

175. I have observed that fresh water acts as a poison to most animals which live in salt water; and since the alcohol has too violent an effect, in producing instant death,

and great contraction of parts, all delicate molluscous animals should be allowed to die slowly amongst fresh-water, and preserved in the above solution instead of spirituous liquors. Objects of this kind must be suspended in the barrel or glass-jars, and too many of them must not be put together. Where the means for preventing the evaporation of the preserving fluids which I have already detailed cannot be had recourse to, the following plan may be adopted: The phial or bottle being properly fitted with a good cork, which at the same time will be a useful medium for suspending the preparation, the following lithocolle must be applied:

176. Common wax and resin are to be melted together in any earthen-ware vessel, and, whilst in a fluid state, red ochre finely pulverized is to be added, stirring all the while with a wooden spatula until the fluid acquires a proper degree of colour. After the mixture has boiled seven or eight minutes, spirits of turpentine must be added, until, by putting small quantities on a piece of glass, it is ascertained to be fine, and possess a degree of elasticity. The mixture dries the moment the heat is reduced, it is to be spread, whilst in a fluid state, over the cork and rim of the bottle. It requires of course to be heated each time it is used, and caution must be used in doing this, as the ingredients are very inflammable, and might give rise to a very dangerous accident any where, but more especially on board a ship. If the cork is completely covered, I am quite sure, by experience, that the evaporation of the spirit will be most effectually prevented; but I should certainly now prefer tying a slip of caoutchouc over the top of the jar, to the use of this troublesome and dangerous luting.

177. It was my intention to have given in this section some instruction for preserving the skins of animals, but I have had little experience in this department of natural history. The preservation of stuffed animals is a distinct branch, and had better be left to the professed naturalist.

Naturalists, I find, have drawn a complete line of demarcation between themselves and the anatomists; and although this is to be regretted, yet it is the lot of all mankind to be perfect in none of their works, and thus the naturalist must stumble on every now and then, receiving a prop or new instructions from succeeding anatomists. In the autumn of 1834, I had the pleasure of shewing one of the most celebrated naturalists in England the salmon ova for the *first time*. Upon the same shelf of our private museum stood a specimen of a salmon smolt; and the naturalist expressing his doubts of its being a smolt, I shewed him the only way of proceeding to satisfy his doubts, viz. to appeal to the anatomy of the viscera, when he would find *that* of the smolt characteristic of a mere infant, whilst a trout of that size (eight inches) was a stout grown up cunning fellow. Mr —— admitted that the field which had thus been pointed out to him was truly magnificent, and entirely new, and stated his determination to follow it out in all his future pursuits in natural history. I strongly suspect, however, that he will find the work of too laborious a nature, and that he will lose that mysterious tact in discriminating new objects of natural history so much dwelt upon by late writers. In 1831 and 1832, when investigating the natural history of the salmon, although our investigations were confined to what was applicable to the whole family, we commenced our inquiry, not by counting the rays of the fins, but by counting the number of vertebræ composing the spine; and I observe that the number of vertebræ in the spine, is now alluded to by most naturalists in their investigations in ichthyology. It was certainly high time to obtain some more fixed character than the fins present, since Sir W. Jardine has confessed that he never in his life could reckon the same number of rays with other naturalists, although the specimens under investigation were undoubtedly the same species. Where the size of the fish will admit of it, and the object sufficiently valuable, an

opening should be made immediately posterior to the pectoral apparatus, as near the spine as possible, and, with a stout pair of probe-pointed scissors, one side removed, by dividing all the ribs and integuments along the side, meeting this incision at the vent by another carried mesially along the abdominal aspect from the sternum. One side of what may be called the walls of the abdominal cavity may be thus removed, displaying all the internal organs *in situ*, and in a most satisfactory way either for preservation or dissection. If to be preserved as a preparation, the mode laid down in section 7. must be resorted to.

178. Few objects of natural history suffer so much, in consequence of the methods taken to preserve them, as serpents. They are generally rolled up and stuffed into a bottle, with a neck so narrow as to render it often impossible to get them out of it without breaking the bottle. Even in great museums they are rolled up and put into bottles in such a manner as, in my opinion, to defy any one distinguishing any peculiar or specific distinctions: and feeling this, when requested to put up a collection for the Royal Society of Edinburgh, I adopted (with me it was an invention) the system of glass-tubes instead of bottles, and I find this mode possesses many advantages. The object is perfectly displayed, and the evaporation of the spirit is almost imperceptible. I closed these tubes with corks and the *lithocolle* mentioned in section 176. Glass-tubes are not easily broken, and it appears to me that the traveller might supply himself with an assortment. At all events, if glass-tubes are not at hand, the specimens should be preserved in very weak spirits, and in an ample vessel, until finally put up in a glass-tube.

INDEX.

FINIS.

ERRATA.

Page 18, line 1, *read* modifications, is
— 39, — 36, *for* which *read* a branch of which
— 50, — 15, *for* membra *read* membrana
— 74, — 25, *for* birds are *read* birds
— 87, — 3, *for* Dugon *read* Duyong
— 90, — 22, *for* know *read* knew
— 116, — 36, *for* herniary *read* hernial

FINIS.